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Examining the impacts of Virginia's data center industry and site location criteria

A COLLABORATION BETWEEN GEORGE MASON UNIVERSITY, OLD DOMINION UNIVERSITY, AND VIRGINIA TECH

Key Findings

In the spirit of the recommendations from the 2019 JLARC study on data center incentives, the Virginia Economic Development Partnership (VEDP) commissioned a group of higher education institutions in 2022 to examine the state's sales and use tax incentive for data centers. University partners were charged with exploring the role of the incentive in generating tax revenue and broader impacts across the Commonwealth, and identifying actions needed to maintain Virginia's competitive position in the data center industry at state and local level. This group was comprised of economic development faculty from George Mason University, Old Dominion University, and Virginia Tech. We reviewed and analyzed existing studies and data detailing the trends and impacts of data centers on the Commonwealth, and we conducted 15 interviews and 3 focus groups with industry experts, data centers, and state and local economic developers.

This study builds on existing data center studies. For instance, a 2022 economic impact study by Mangum Economics LLC for the Northern Virginia Technology Council (NVTC) estimated that Virginia data centers generated $15.3 billion in economic output in 2021, with $174 million going to state tax revenue and $1 billion going to local tax revenue. The 2019 JLARC study also highlighted economic impacts from data centers, concluding that data centers increase the Commonwealth's GDP by as much as $1.3 billion annually. The study's "but-for" cost analysis attributed 90% of Virginia's data center economic activity directly to the state's sales and use tax incentive. This study added to these findings, exploring nuance and broader impacts of data centers, the state's sales and use tax incentive, and other factors contributing to data center industry site location and growth

Impacts of Data Centers

- Data center industry value chains focus on utilities (electric power, water, telecommunications), equipment and related parts and components, software, professional services, and construction trades and materials. In Northern Virginia, specialized construction contracting firms are continuously employed for both new data center development and the expansion of existing data centers.
- Today, data centers employ over 13,000 workers across Virginia, about a 47% increase since 1990. In 2021, the industry contributed $2.2 billion in total wages in the state. Since 2013 there have been 47 public announcements for data processing, hosting, and related services in Virginia totaling 2,234 jobs and over $9.6 billion of investment.
- Data centers have a broad and lasting impact on Virginia's communities that cannot be quantified. They tend to embrace a community-focused ethos and engage in many activities to support community development. These activities include volunteerism with local organizations, community grants and donations, improvement of community infrastructure such as broadband and roads, monetary and programmatic support of education and workforce programs, and supporting entrepreneurship and business development through business services and funding.

Influence of Virginia's sales and use tax incentive

- At the state level, the sales and use tax incentive is essential for maintaining Virginia's lead in data center development. This type of incentive is widely adopted across competitor states. Without the existing sales and use tax exemption, industry experts and observers believe that many data center developers would remove Virginia from consideration of future investments.
- The 2035 sunset clause is already a concern for data center developers and operators, who are making investment decisions as far as 20 years in advance. Few of the existing and emerging competitor states have sunset provisions for the data center focused incentive programs. We suggest consideration be given to revising the sunset clause to maintain the Commonwealth's competitive position.
- The job growth metric threshold under the state incentive program for data centers should be reviewed and should cover a larger geographic area than the one locality where the center is located. For example, there is reportedly an emerging trend where data center employees are shared across multiple facilities for the same company, which are sometimes located in a different jurisdiction. This can make the employee count qualification hard to meet and may discourage the development of small data centers, or edge data centers, that are appropriately scaled for development in non-urban areas—even with the current lower thresholds for disadvantaged communities. Most localities interviewed revealed that the primary goal of attracting data centers is not for job growth but for the tax revenue generated to localities. Tax revenues from data centers are significant and can translate to better economic and community infrastructure, from schools to broadband. These tax revenues are particularly useful for those counties with dwindling population tax bases and can serve as catalysts for growth.

Important local sight selection criteria

- When evaluating prospective local sites, power and fiber optic telecommunications lines are the most important criteria for data centers. Data centers are looking for enough power and sufficient redundancy in the power and fiber networks. Because they use so much power, data centers are also looking for multiple sources of power such as carbon-neutral sources like solar, wind, and nuclear to offset their traditional power consumption. Other key site selection criteria include cooling water availability and a friendly regulatory environment. The presence of qualified workers, particularly construction workers specialized in data center construction, was also a desired, but secondary criteria. Customers of co-location data centers are increasingly requesting data centers that are at least partially powered by renewable resources.
- Key informants highlighted the distinct need for consistency and dependability in data center infrastructure as well as land and business policy. Localities need to convey this consistency in their actions and messaging to data center operators and developers.

- Political and public opinion of data centers is becoming a growing criterion that concerns the industry. As major population centers grow and spread to areas near existing data centers, political animosity toward data centers has grown. Some communities have expressed concerns of noise pollution from data centers and rising land costs while other stakeholders expressed concerns that some residents are not aware of the benefits that the data center industry brings. Key informants expressed a need for more education about data centers and their benefits to localities.
- With sustainability in mind, prospective data centers are very cognizant and cautious of natural disaster risks, particularly as they pertain to future climate change challenges. Many key informants, for instance, said the perceived vulnerabilities of Hampton Roads to climate change and sea level rise could dissuade data centers from locating in that region.
- Some industry experts indicate that if data centers looking to locate or expand in the Northern Virginia region were unable to find available sites, they may be more likely to consider sites outside of Virginia rather than sites in a different region within the state. This is not to say that existing data center clusters cannot spread to adjacent or nearby areas, but if barriers to adjacent growth emerge due to infrastructure, labor availability, or regulatory issues (local zoning, etc.), the next location choice for a developer could easily be in another state.

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Introduction

In recent years, studies by the Joint Legislative Audit & Review Commission (JLARC) and the private consulting firm, Mangum Economics LLC, have provided economic assessments of Virginia's data center industry. In March 2022, Mangum estimated that Virginia data centers generated $15.3 billion in economic output in 2021, with $174 million going to state tax revenue and $1 billion going to local tax revenue. The study also explained that "For every job inside a Virginia data center, there are 4.1 additional jobs that are supported in the rest of the Virginia economy."[i] Meanwhile, the 2019 JLARC study on data center and manufacturing incentives examined the data center sales and use tax exemption, Virginia's largest incentive program. JLARC's study found that the sales and use tax incentive was effective in influencing data centers to locate in Virginia and helped to increase Virginia's GDP by $1.3 billion annually. However, the study called for further exploration of the incentive's role in tax revenue generation and broader impacts across the Commonwealth. Particularly, the study recommended identifying actions needed to maintain Virginia's competitive position in the data center industry.[ii]

In late summer of 2022, the Virginia Economic Development Partnership (VEDP) commissioned a group of higher education institutions to review previous findings about the data center industry and examine further the importance of the sales and use tax incentive for data center attraction and retention. This group was comprised of economic development faculty from George Mason University, Old Dominion University, and Virginia Tech. Specifically, VEDP requested the group to:

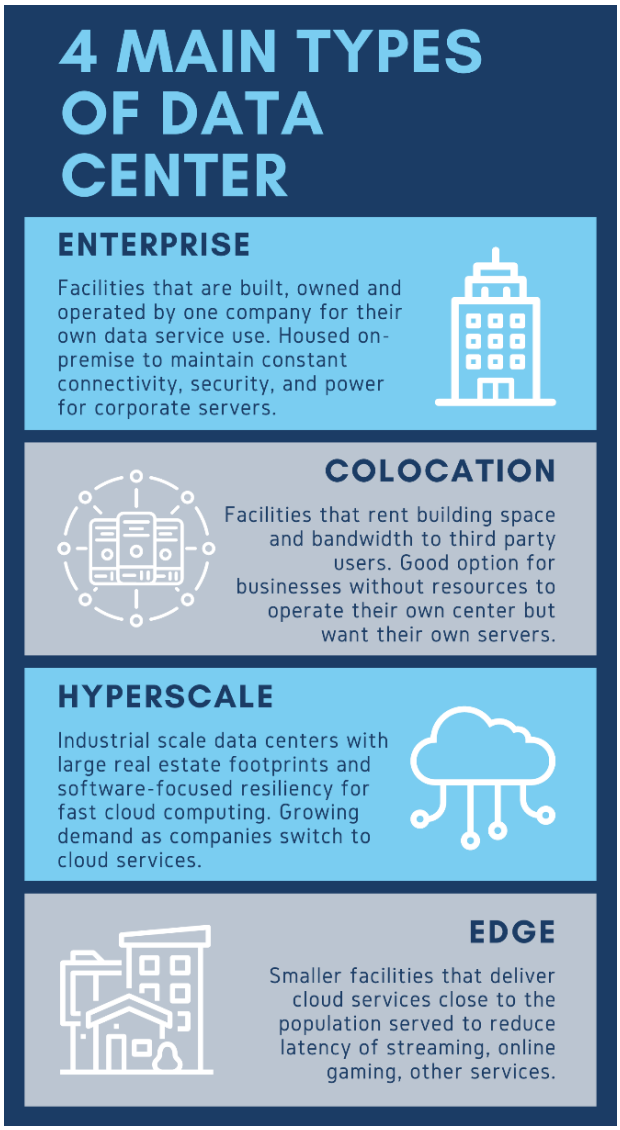
1. Examine site location drivers for data centers and benchmark those with competitor states to assess what factors are needed to maintain Virginia's competitiveness
2. Explore multifaceted impacts of data centers including upstream and downstream impacts, tax revenue, and other impacts not necessarily revealed in a traditional economic impact analysis
3. Provide a basic overview on data center industry trends and growth prospects
4. Support VEDP and state decision making on pursuing economic development opportunities in the data center industry across the Commonwealth.

To accomplish these objectives, university partners reviewed and vetted the methodologies of past reports; gathered and analyzed industry trend data; and conducted 15 interviews and 3 focus groups with state and local economic developers, industry experts, and data centers and their value chain suppliers across the state.

This report provides a brief overview of Virginia's data center industry including industry trends, an economic analysis of the data center value chain and industry impacts, a description of broader impacts cited by stakeholders across the Commonwealth, and a review of key site selection factors for attracting and retaining data centers in the future.

Virginia's Data Center Industry

Nationally and globally, the data center industry continues to grow due to ever-increasing demand from hybrid work, online gaming, social media platforms, and numerous streaming applications. This demand does not account for the substantial number of consumers who may come online as a result of recent broadband infrastructure expansion efforts in previously underserved rural and urban areas. As a result, data centers are scrambling to expand their capacity by leasing any available space and constructing new facilities. In the past decade, the number of data center locations in the United States increased by 150%.[iii] At the beginning of 2022, data center storage supply in primary markets increased 20% from the previous year, totaling 627.3 MW of new capacity.[iv] In mid-2022, projected data center construction may increase computing capacity by as much as 1,913 MW across the nation's primary markets, representing a three-fold growth in national capacity on a year-over-year basis. More than half of this new capacity is expected to come from Northern Virginia alone.[v] Since 2013 there have been 47 public announcements for data processing, hosting, and related services in Virginia totaling 2,234 jobs and over $9.6 billion of investment.[vi]



Northern Virginia is host to the largest cluster of data centers in North America, and perhaps the world. The region is a hotspot for data centers for multiple reasons. Northern Virginia is home to MAE-East which was one of the first network access points, allowing the region to gain a foothold in the industry at its birth. Northern Virginia has lower power costs compared to average prices across the country. In addition, there is a high density of dark fiber routes which provide low-latency connections and redundancies in case of a problem in the network.[vii] These factors, combined with highly competitive tax (incentive) structure, supportive local regulation, a low risk of natural disasters and seismic activity, have propelled the region as a hub for data centers and center of connectivity for cloud service providers.

Figure 1. Map of Virginia Data Centers (Source: VEDP)

Northern Virginia is not the only region of the Commonwealth with data centers. Even in 1990, data centers were in Central Virginia, Hampton Roads, Southern Virginia, and the Shenandoah Valley. Since 2016, Southwest Virginia has continuously hosted data centers. Today, data centers employ as many as 13,248 workers across Virginia, about a 47% increase since 1990.[viii] In 2021, the industry contributed $2.2 billion in total wages in the state.[ix] According to one of the leading real estate firms for data centers, JLL, about 58% of Virginia data centers are used for cloud computing; 30% stream entertainment and media; and 12% provide services to other industries.[x]

Notable Industry Trends

As demand for data centers grows, many data center site selectors are looking as much as 20 years ahead at larger sites so they can implement more scalable expansion models. Persistent supply chain issues have increased overall costs of constructing data centers. To mitigate this cost, many data centers are turning to scalable models of construction. They are looking for larger sites, typically greenfield sites of 50+ acres, to grow their center over time.

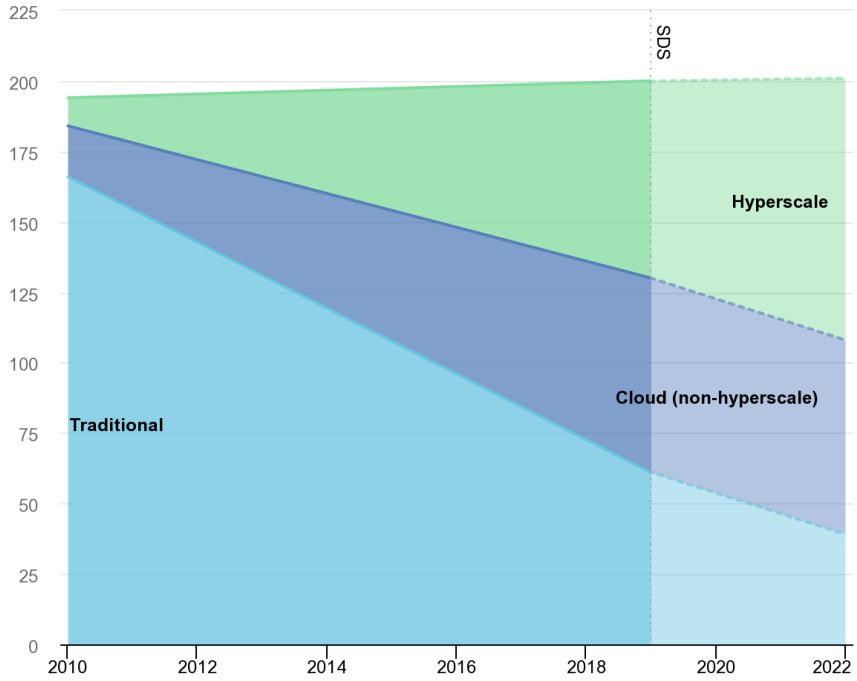
Demand for hyperscale data centers is expected to grow as more firms switch from managing their own data assets to either full cloud or hybrid models. A Cisco survey of 2,500 IT decision makers revealed that about 82% have already initiated hybrid cloud strategies. Global spending on cloud infrastructure has steadily increased to $178.0 billion in 2021.[xi]

Availability of land and power may hinder data center growth in many major markets, driving expansion outside of traditional hubs.[xii] Traditionally, data centers tend to cluster due to

infrastructure requirements and the desire to be in proximity to competitors and hyperscale data centers. Today, the cost of land in northern Virginia counties and recent uncertainty about power supply capacities have encouraged newer data centers to look further south, closer to Richmond VA, or to other states. Key informants confirmed this trend, citing Atlanta, GA and Columbus, OH as desirable alternative locations.

Changes in technology have increased demand for power. Server technology is becoming increasingly smaller, allowing for more servers to occupy smaller physical footprints. As a result, more power is needed to run and cool this larger and higher density network of servers. Dominion Energy, which is the largest energy supplier in the state, has connected close to 70 data centers with over 2.6 gigawatts of capacity in Northern Virginia since 2019, equivalent to powering more than 650,000 homes. Data centers account for 20% of the company's sales.[xiii] Dominion is rapidly expanding plans for new transmission lines and substations to handle increased demand. However, supply chain delays and permitting may slow this process and impede the desired speed of industry growth.

Concerns about sustainability have data centers exploring ways to implement net-zero-carbon strategies and avoid any negative effects of climate change. Data centers represent a high energy-consuming and water-dependent industry. A typical medium-sized data center producing 15 megawatt hours annually will use as much potable water as three hospitals or two 18-hole golf courses.[xiv] Key informants described how data centers are examining ways of reducing water consumption through alternative methods of cooling and by using grey water instead of potable water. With respect to power, global data center energy consumption was 190.8 terawatt hours in 2021. Hyperscale data centers used 87 terawatt hours, almost doubling consumption since 2017. Traditional data centers (Enterprise and colocation) more than halved their consumption, going from 70 terawatt hours in 2017 to 33 terawatt hours in 2021.[xv]



In addition to finding ways of becoming more energy efficient, many data centers actively purchase a portion of their power from renewable energy sources such as solar or wind. Others have bought their own solar power systems to supplement the power they draw from the larger energy grid. Some companies are even looking to technological changes in nuclear and hydrogen power as a means of sustaining their growth. The data center industry has emerged as a key driver of the development of solar electric power generation in Virginia, contributing to the state's progress toward environmental sustainability.[xvi]

As residential neighborhoods expand into localities with data centers and as those data centers continue to grow, political tensions may increase. While this is not a national trend, Northern Virginia's experience with data centers and changing public opinion may be an indication of what may come for other data center hubs. As Northern Virginia has grown, the distance separating residential neighborhoods and data centers has shrunk. Complaints include the noise that data centers produce and the exorbitant land requirements for data centers, which make land acquisition by smaller businesses significantly more difficult.

State Incentives and Site Selection

For at least the past 30 years, economic studies on the effectiveness of state and local tax incentive programs on business location decisions have produced mixed results.[xvii] The economic development literature identifies the factors that motivate firms to relocate, and the factors that weigh into their location choices. According to this literature, firms cite a range of reasons for seeking a new location—cost savings, consolidation of operations, accommodation of business growth or decline, self-interest, and proximity to relevant networks.[xviii] Other factors in location decisions include transportation infrastructure, site/building quality, property costs, and quality of available workforce.[xix] The most frequently cited reason for a firm's location decision is profit maximization.[xx]

A firm's location decision often follows a general process where alternatives are weighed based on certain criteria. Firms and site selection consultants typically start with a larger group of communities and then narrow their choices to a smaller set of communities where site visits are conducted, and detailed information is collected. Accordingly, to be competitive in attracting firms, states must be actively involved with prospective firms as they seek the appropriate information in their decision process. An understanding of the factors that are most important for firms seeking location is essential for states to provide relevant, attractive, timely and appropriate information.

In his 2018 study, Bartik estimated "but for" percentages from 30 of 34 different studies he surveyed that examined the effect of taxes on economic development. Bartik considered whether studies assessed the effects of incentives in a single state, whether they compared jurisdictional variation in the utilization of incentives with a single state, and whether they used data from multiple states. Using a regression meta-analysis of 34 estimates, Bartik performed a regression of the "but for" percentage to produce an overall estimate of the effect size. Bartik later performed a similar analysis examining data center incentives, discovering these "but for"

percentages to be significantly higher for the data centers industry than for other industries. In its 2019 Evaluation of the Data Center Incentive, the Joint Legislative Audit and Review Commission (JLARC) found a "but-for" percentage of 90%, suggesting that in 90 percent of the cases where a firm received the sale and use tax exemption, the incented project was tipped by the incentive. Another way to think of this, in policy debates incentives are described in terms of "costs" based on the amount of foregone tax revenue. The JLARC analysis is saying that there is actually little *foregone* tax revenue because without the incentive, most of the data centers and their tax revenue would not be in Virginia. Importantly, the estimates by JLARC are based on the Bartik method described above. Taken together, this suggests that data center site location decisions are more heavily influenced by incentive offerings compared to most industries.[xxi]

Data Center Incentives in Other States

Virginia was an early entrant in using tax policy to effectively compete for investments in data centers as an industry. As described in JLARC's 2019 report, the first incentive program in Virginia targeted to the data center industry was enacted in 2008 exempting state sales tax obligations on purchases of data processing, communication, storage, and retrieval equipment purchased by the end of the 2011 fiscal year. The incentive was limited to data centers locating in jurisdictions with relatively high unemployment rates (>4.9%) and required a minimum of $75 million in total capital investment and the creation of 100 new jobs. The incentive program expanded in 2010 in response to competition from North Carolina by adding sales and use tax exemptions for the purchase of hardware and equipment supporting data center operations and also extending the incentive period through 2020. Also, in 2010, Virginia lowered the sales tax exemption eligibility threshold for companies building data centers in economically-challenged locales. Incentive program eligibility requirements were modified in 2012 to count employees of co-location data center tenants towards the overall job creation criterion. In 2016, the sunset date for this incentive program was extended to 2035 and allowed flexibility in the job creation requirements for larger projects (capital investments of $500 million or more).

Virginia is facing increasing competition as land prices and power concerns increase in Northern Virginia. Many data centers are considering secondary markets to locate as other states signal their desire to host data center facilities.

- Thirty-three other states now have tax-related incentives that support data centers. Twenty-nine states have incentives specifically for data centers. Four other states have broader incentives that apply to data centers.
- Only 23 have sunset clauses or time limits for their incentives.
    - Seven states currently have sunset clauses: Arizona, Georgia, South Carolina, Washington, West Virginia.
    - Sixteen states currently have some time limit on incentives that begins with the start of a project: Alabama, Arizona, Indiana, Maryland, Minnesota, Mississippi, Missouri, Nevada, Ohio, Texas

        - Given the comparatively frequent refresh of data center capital investments, it seems that incentive programs with time limits may be practically permanent in nature, ending only when a state legislature chooses to alter state policies. This would be more advantageous for data centers as compared to the quickly approaching sunset date in Virginia.
- Eligibility puts greater emphasis on capital investment than job creation. Typical capital investment criteria range from $50-$200 million. At least seven states have completely phased out job creation requirements (Arizona, Florida, Indiana, Iowa, New Mexico, North Carolina, and Ohio).

Appendix C lists and describes competitor states with incentive programs.

Overview of data center economics

Lifecycle phases	Taxable events	Primary direct revenue streams
Initial construction 	▪ Land purchase, infrastructure improvements, and site preparation ▪ Construction of shell buildings (up to 250k sqft or larger) ▪ Initial installation of heavy equipment and servers	▪ Income Tax on construction workers ▪ Sales Tax on construction materials and non-exempt equipment ▪ Recordation Tax
On-going operation 	▪ Personnel costs (direct employment) ▪ Contractors & support staff ▪ Utility consumption (electricity, water) ▪ On-going maintenance	▪ Income Tax on workers and contactors ▪ Real Estate & Tangible Personal Property Tax ▪ Electric Utility Consumption Tax
Refresh / expansion 	▪ Refresh investments to replace expended servers and other equipment ▪ Construction and installation of new equipment associated with expansions ▪ New direct employment associated with expansions	▪ Income Tax on construction workers and new direct employment ▪ Sales Tax on construction materials and non-exempt equipment

VEDP

Data Center Value Chains and the Impacts of the Data Center Industry

Data centers, as discussed later in this section and elsewhere in this analysis, are important contributors to state economic growth and development, particularly for localities. Their industry dynamics are somewhat different than traditional highly interconnected industry clusters like aircraft manufacturing, financial services, healthcare services, and other industry clusters. This does not mean that there are not recognizable patterns of industry co-development and co-location. In this section, we examine upstream and downstream value chains for the data center industry through a business activity framework with consideration of ongoing and future economic development opportunities.

Data Center Industry Suppliers

The largest broadly defined supply sector for data centers are utility providers, which include electric services, treated water services, and wired (fiber optic) telecommunications. Some industry publications estimate that electricity represents more than 20% of total operating costs, though this likely varies widely based on the type and nature of the data center. Other sectors support data center development (building construction and equipping facilities) and ongoing operations including:

- Professional Services (legal, engineering, consulting, management, marketing, other)
    - Interglobix
    - Timmons Group
    - Windward Consulting
    - Hurley
- Data Services (computer programming, systems design, and related services)
    - Compu Dynamics
    - Fulcrum Collaborations
- Equipment manufacturers (servers and related air handling, power management, cooling)
    - Modine
    - Aggreko North America
    - Munters
- Real Estate Services
    - JLL, CBRE
- Site Development and Construction Related Services
    - Rosendin Electric
- Building Services including Security Services
    - Technoguard

Construction Contractors and Materials Suppliers directly gain over $2 billion in economic activity statewide according to the most recent industry study conducted for the Northern

Virginia Technology Council.[xxii] This includes new facility construction but importantly also includes the expansion of existing facilities along with recurring renovations. In Northern Virginia, a subsector of contractors and suppliers who specialize in data center construction activities emerged over the past 15-plus years, with some having transitioned to effectively exporting their services for data center developers in other states. The investments in data-center-related land development and construction are often described as temporary economic activities – once the construction project finishes, the economic benefits of those activities cease. With the continued growth of this industry, there is a sufficient market base to support site locations for existing firms and the emergence of new businesses providing specialized construction-related services that are wholly or largely supported by the existing data center industry. This also includes a growing cohort of firms in computing design and architecture, server-related equipment suppliers and maintenance services, and other business activities.

The Value of the Data Center Industry and Its Supplier Networks

As noted, the NVTC recently released a study of the economic and fiscal contributions of the data center industry on the Commonwealth of Virginia and defined sub-state regions. Given the recency of this report, which used 2021 data, the university partners did not duplicate this work. The team did engage in a thorough examination of the data sources, methods, and assumptions used for the NVTC study that included a detailed engagement with Mangum Economics, LLC.[xxiii]

The NVTC study uses data gathered from VEDP and other reputable sources and employs the IMPLAN economic input-output model developed by MIG, Incorporated. The IMPLAN model is widely used in academic and professional research and is the model university partners employ for such analyses. Input-output models use industry interaction benchmark data from the U.S. Bureau of Economic Analysis to estimate how business activity in a target sector spreads across a regional or state economy. Direct effects are derived from spending by the given industry, such as data centers purchasing equipment, supplies, and professional services as a part of on-going business operations. A separate category of spending by the data center industry covers facility development including construction and equipment acquisition. Indirect effects capture the value of economic activity across data center industry value chains. For example, the co-location data center hires a marketing firm to create an advertising campaign. In turn, the marketing firm hires employees, contracts with a graphic design firm, and retains an accountant to prepare its tax returns. The accountant hires bookkeepers, rents office space, and employs a janitorial service, and so on. The model accounts for value chain spending that likely leaves the study area, such as the graphic design firm using specialized printers that are not manufactured in Virginia. Induced effects capture the economic value of proportional household spending of the employees of all of these firms for goods and services in the study region.

The IMPLAN model uses a sector classification scheme that separates economic activity into 546 industries. Some of these sectors represent aggregations of similar industries, which can introduce some measurement error in the analysis. For example, the IMPLAN industry code

that includes data centers also covers other similar industries, such as data processing, hosting websites, and computing facilities. The commodity and services consumption patterns may not match those by data centers alone. However, experience shows such variations do not have meaningful impacts on the total estimates of industry economic and fiscal contributions. We find the NVTC analysis to be credible and appropriately conservative in its methodology and assumptions.

The industry classification limitations noted in input-output and similar economic models also impacts data quality related to data center industry employment. Secondary employment data from sources like the U.S. Bureau of Labor Statistics also aggregate job counts across similar industries, which means that there are no publicly available job counts specific to the data center industry sector. The analyses use data and information from multiple sources to make a best estimate of jobs counts in DCs. Data centers themselves are secretive about disclosing employment counts for confidentiality and competitive purposes. Future analyses will be aided by forthcoming data from VEDP who will be able to track detailed employment information from companies receiving sales and use tax exemptions. [xxiv] Given the conservative nature of part economic impacts analyses, the availability of additional VEDP data will likely result in a better understanding of the magnitude of the impacts of this industry.

Importantly, the economic interactions described by the indirect effects in an input-output analysis, when scaled up at the industry level, offer potential targets of opportunity for business development and attraction. Some of this emerges organically, like the specialized construction firms described above. Others can become a part of a targeted industry approach to economic development that builds on existing demand for the providers of intermediate goods and services. Among specific potential opportunities:

- Entrepreneurial firms exploring new energy management systems, especially those that balance loads across traditional and renewable energy sources;
- Energy storage systems to enhance power resiliency for renewable energy source base loads;
- Explore small form nuclear power generation to support the energy needs of geographically clustered data centers (investments in such power generation facilities could lure data center investments to non-urban areas of the state);
- Air cooling systems for servers that enhance energy conservation and match the effectiveness of water-cooling systems;
- Network architectures;
- Products and services focused on data security.

Based on the analysis provided in the NVTC report, in 2021 more than $2 billion in direct spending went towards building and expanding data centers in Virginia, which generated more than $3.3 billion in total economic activity and supported 16,900 jobs that paid almost $1.2 billion in salaries, wages, and benefits (see Table X.1 below). Mangum Economics estimates that recurring operations at data centers located in Virginia had a direct output exceeding $5.5

billion, which boosted state economic activity by $11.9 billion, increased labor income by $2.5 billion, and supported 28,550 total jobs. Overall, in 2021 data centers generated almost $15.3 billion in state economic activity and increased labor income by $3.6 billion paid through 45,460 direct, indirect, and induced jobs. This economic activity also generates state and local taxes. The IMPLAN model estimates that data-center-related economic activity in 2021 created over $1 billion in revenue for local jurisdictions and $174 million for the state. However, state revenues are offset to a large extent by targeted tax exemptions. The Joint Legislative Audit and Review Commission's (JLARC) most recent analysis suggests that the state received $1.09 dollars in revenues for every $1.00 in tax incentives awarded to qualifying data centers.[xxv] Updating the net return on tax incentives is beyond the scope of this current project, but using the 2017 estimates suggests that the state still nets more than $16 million in revenue from data centers, not including any reduction in local education funding obligations the state enjoys due to local governments receiving data center generated revenues.[xxvi]

Table 2. Economic Contributions of Virginia's Data Center Industry, 2021

Description	Construction	Operations	Total
Economic Activity	$ 3,335,700,000	$ 11,941,600,000	$ 15,277,300,000
Labor Income	$ 1,171,800,000	$ 2,465,500,000	$ 3,637,300,000
Jobs	16,910	28,550	45,460

Source: NVTC, Mangum Economics

Data Center Customers

The downstream side of the data center industry does not behave like traditional industry clusters. First, there are fewer sectors of the economy, including households, that are not directly or indirectly customers of data centers. Social media, cloud storage for music and pictures, streaming media services, and others require hordes of data. However, there is little direct evidence that suggests that data center customers (businesses) specifically use the presence of data centers as a factor in their site location decisions. Some customers of co-location facilities will specify that they prefer to have their data stored on servers in a given nation or state, but that does not appear to be related to the location of their headquarters or operations facilities. Enterprise facilities may be located in proximity to the owner organization, but it is not a clear pattern of predictable site selection behavior. Conversations with several industry experts consistently revealed little downstream spillover effect in business development or attraction opportunities associated with data centers. One key informant dispelled a common myth that data centers used to support stock trades need to be located in close proximity to New York City, usually northern New Jersey, to have a competitive edge in the timing of trades. Reportedly, the relationship between data transmission latency and geographic proximity matters to some data center clients such as streaming clients; however, interview responses did not point to a consistent proximity requirement.

There is a clearly observable cluster effect for data centers themselves, especially co-location facility competitors. The presence of a critical mass of developable "site ready" properties,

sufficient utility infrastructure to support current and future needs, reasonably available labor, and supportive public policies – including competitive incentives, and the presence of an initial data center or two, is a strong attractant for continuing investment in these facilities. Nothing draws a crowd of data centers like having a lot of data centers – with spare electric power.

Broader Impacts of the VA Data Center Industry

The research team engaged data center industry experts and stakeholders and reviewed industry materials to learn more about the impacts that data centers have on the communities they serve. The following areas reflect many of the ways that data centers engage with and contribute to their surrounding communities.

Community Engagement and Investment

Many data center companies, such as Google, have volunteerism built into company culture. Employees are encouraged to serve with local organizations, volunteer at events, and more. As a result, data center representatives and personnel are often involved in local organizations and public forums such as local Chambers of Commerce, Board of Supervisors' convenings, and local and regional nonprofits.

Many companies build ongoing relationships and engagement with their communities. For instance, Iron Mountain worked with Prince William County to address public concerns about power and water usage by updating the company's practices onsite, including shifting from a water retention to detention system to help with stormwater runoff.

Many of the data centers examined in this research have histories of grant programs and community investment that support local and regional organizations, small business and entrepreneurship, and capital improvements in their respective areas. Examples include:

- Meta, located in Henrico County, VA, developed the Data Center Community Action Grants program that provides funding to nearby communities to address critical needs with technology-based approaches, improving connectivity, and improving local STEM education. During the pandemic, the company also administered COVID-19 relief grants to 100 small businesses in partnership with ChamberRVA. As of 2022, Meta has contributed over $1M in community support to the Henrico County area.
- Since 2012, Google has awarded over $20M in grants to nonprofits and organizations based in Virginia, including $150,000 to organizations including the Loudoun Wildlife Conservancy, Potomac Conservancy, and A Farm Less Ordinary. Google also provided an additional $150,000 to the Loudoun Education Foundation in 2020 to help the school district with the transition to remote learning in the face of the Coronavirus pandemic. Additionally, Google employees in Virginia have donated over $4M in charitable giving to nonprofits and served over 7,100 hours of volunteer work with nonprofits and schools.
- Since 2016, Microsoft has donated more than $2.8 million across 91 projects supporting community-identified priorities in the Virginia counties of Mecklenburg, Halifax, Charlotte, Lunenburg, Brunswick, and Loudoun. With a grant from Microsoft Community Development, local nonprofit "The Better Block" developed a pilot program in Boydton to promote community gathering with parklets and pop-up outdoor seating areas.[xxvii]

- Digital Realty in Northern Virginia participated in the Adopt-A-Highway program where the company's Culture Club adopted Smith Switch Road between Waxpool and Gloucester, hosting clean-up events and fostering stewardship of the environment.

Infrastructure

The local tax revenue data centers provide individually and collectively is significant. Many localities have used this additional revenue to invest in county infrastructure, from building better schools to developing broadband infrastructure. Indeed, data centers are often catalysts for new infrastructure and capital investment in their communities—particularly when it comes to fiber and connectivity and alternative energy. Industry desire for alternate power, including renewables and elemental power, is accelerating the rate of research and development of those technologies. Google, for instance, has partnered with Loudon County to provide public Wi-Fi hotspots in the area.

Additional tax revenue for infrastructure poses a particularly good opportunity for more rural counties with dwindling populations. As more rural counties in the Commonwealth lose population, they also lose their tax base, leading to a vicious cycle of declining infrastructure and social amenities that would support and help retain the remaining population. Provided these regions can attract and retain data centers, the additional revenue would help to support infrastructure needs. Moreover, this infrastructure development, in turn, makes localities more attractive for investment from a broader set of industries and firms. Several key informants noted that data centers were ideal for these situations because they do not rely on a large workforce but still provide significant tax revenue that could help to break this cycle of decline for rural regions.

Alternative and Renewable Energy

The growth of the data center industry, among other factors, has driven efforts to plan and develop alternative and renewable energy capacity across the state. Data center companies and their clients have aggressive environmental sustainability goals that often outpace those of the state and its localities. Many are looking to offset their power consumption with "clean energy," while other operators are making efforts to become more self-sufficient by generating their own power.

The capital investment from data centers may act as an incentive for localities to invest in renewable energy as well. According to the 2022 economic impact study by Mangum Economics LLC, data centers in Virginia have helped to create demand for $3.4 billion of investment in Virginia solar energy projects.

- Google data centers are continuing to meet company-wide goals of matching all energy consumed with clean energy, by hour, for 24 hours a day, 7 days a week—a metric the company has consistently met since 2017.
- By 2023, Amazon plans to enable 15 new utility scale solar farms across Virginia, with a total capacity of 1,430 megawatts (MW), and total investment of $2.1 billion. According

to AWS estimates, the construction will support 6,050 jobs in the state. [xxviii] When all 15 projects are in operation, participating counties are projected to receive up to $2 million in tax contributions annually during the project lifetime. [xxix]

- Meta is planning future contracted projects in the state that will add 850 MW of new renewable energy, representing an estimated $230 million in local investment. In Henrico County, VA, Meta also helped to promote connectivity by partnering with the Henrico County Public Libraries to create a Wi-Fi hotspot lending program.

Workforce and Education

Several data center companies work intensively with local and regional economic development, higher educational institutions and other partners to strengthen talent pipelines, promote STEM education, and further employment opportunities for residents.

- Almost all data center companies participating in this study showed preference for hiring, training, and upskilling local workers to meet their workforce needs.
- Some companies reach out directly to local school systems and robotics, welding, and STEM clubs to raise awareness of the data center industry and career opportunities among K-12 students—sometimes even leading students tours of data center facilities.
- The Google Career Certificates program provides online job training, networks, and resources to prepare job seekers for careers in data analytics and IT Support. The $100M Google Career Certificates Fund supports nonprofit Social Finance in its efforts to serve job seekers. The Google Career Certificates are also free to access for all community colleges and career and technical education (CTE) high schools.[xxx]
- Microsoft collaborates with Southern Virginia Higher Education Center, Southern Virginia Community College and the Loudoun Freedom Center to facilitate workforce training through its Datacenter Academy program. The program prepares students for careers in IT, including work in datacenters through training and even lab work that simulates a physical data center environment. In 2022, 195 participants completed the training program.[xxxi]
- Meta investment in the Henrico County, VA region supports STEM education and hands-on learning for students in the region. Meta, in partnership with CodeVA, founded an intramural robotics league across the central Virginia region. Meta has also helped to develop a Technology for Teens Center at the Boys and Girls Club of Metropolitan Richmond and helped to launch an afterschool STEM program in partnership with the Henrico Police Athletic Club.
- AWS provides several collaborative workforce initiatives across the state, including the AWS Academy, where Virginia educators get access to free cloud computing curricula that prepares students to pursue industry-recognized AWS Certifications and in-demand cloud jobs.[xxxii] Additionally, the AWS Educate program provides users with free online cloud learning resources. AWS re/Start is a full-time training program that prepares

unemployed and underemployed individuals for careers in the cloud and connects them to potential employers in Virginia.

Entrepreneurship and Small Businesses

Data centers, specifically co-location facilities, often provide support to businesses and ventures as a fundamental aspect of their operations. Users of these co-location data centers tend to be small and local businesses. Additionally, other data centers such as enterprise centers manage programs and engage with their communities to foster entrepreneurship and small business opportunities.

- Many data centers, including Meta, Google, and Amazon, provided grants to help mitigate the impacts of the Coronavirus pandemic on small businesses.
- Google worked with the Opportunity Finance Network (OFN) to establish the Grow with Google Small Business Fund and OFN's Grant Program. The $185M program funded loans to over 50 community development financial institutions (CDFIs) including Latino Economic Development Center (LEDC), Washington Area Community Investment Fund (WACIF), and others in Virginia, including $50M to supporting Black-owned businesses.[xxxiii]
- Microsoft and Mid-Atlantic Broadband Communities Corporate partnered to create the SOVA Innovation Hub in Halifax County, VA. The Hub serves as a centralized location for innovation, training, digital skills education and more, with coworking space as well as the Microsoft Experience Center.[xxxiv]

Findings Regarding Site Selection and Industry Retention

In a review of incentives from competitor states, university partners found that over thirty states have or are developing incentives targeting data center attraction and retention. The competitive landscape for state incentives for data centers is constantly changing. The number of states with targeted incentives is growing, and many of these states have chosen to not have sunset provisions in their policymaking, making the choice that state legislatures *always* have the authority to rescind an incentive policy every time they are in session. Some states that do not have data-center-specific incentive programs are still very competitive because of broader incentive or state taxing policies. This results in a highly diverse set of policies that impact state competition for data center investments. Key informants indicated that Virginia is facing increasingly intense competition for data center investments and the current sunset provision of the existing sales tax exemption program is boosting the prospects of the Commonwealth's competitors. A list of state data center incentives is in Appendix C of this report.

Virginia's sales and use tax incentive is essential for attracting and retaining data centers. All stakeholders were unanimous in stating the importance of Virginia's sales and use tax incentive. While the tax incentive is not the deciding factor for site location—indeed, some data centers do not even use the incentive—the incentive was essential for even considering Virginia as a potential location for prospective data centers. Data centers and industry experts explained that the first round of site selection often entails a brief analysis of state incentives and overall state capacity to host data centers (connectivity and power). Since many states now offer similar incentives to Virginia's sales and use tax exemption, data centers specifically look for those as indicators that the state is friendly and serious about supporting the data center industry. States without the incentive are often removed from consideration early in the site selection process.

The sunset clause on Virginia's sales and use tax incentive is another concern for stakeholders as its 2035 deadline approaches. According to several stakeholders interviewed, data centers have begun factoring the sunset date into their site selection calculations. As they are planning at least 10 years ahead, often more, the sunset clause is an ever-growing concern. They perceive the lack of action by the state to be a signal that Virginia may no longer be supportive of the industry. One stakeholder said they would not recommend Virginia at this time, primarily because of the sunset clause, but also due to other negative signals they have received from localities, which are reportedly due to spillover effects of data centers located in close proximity to residences. We suggest consideration be given to revising the sunset clause to maintain the Commonwealth's competitive position.

Stakeholders found the eligibility threshold of 50 new jobs within the locality of residence to be difficult to meet and not reflective of the primary goal of having data centers in a community. Construction of data centers provides many jobs. Indeed, the data center construction market has been so active as to create niche expertise among contractors in Northern and Central Virginia. While operating data centers provide a small number of high

wage jobs, they are not necessarily valued solely for their employment prospects. Both data centers and local officials said they mostly value the tax revenue going into local infrastructure development and maintenance. In this context, achieving 50 new jobs within one county is difficult to achieve and not always the most desired outcome. This is particularly true among smaller data centers and in communities with an already tight labor force. Already, the threshold has been reduced for more rural and distressed communities. Others have suggested rethinking the number all together and broadening the geographic boundary of jobs to the larger economic region as opposed to just one locality.

After choosing states in which to look for a site, data centers prioritize site size and preparedness, broadband connectivity and redundancy, and power. All stakeholders emphasized the importance of having an appropriately sized site with good internet connectivity and enough power. Connectivity and reliable power are the foremost considerations for site selection. Smaller data centers may need only 5-20 acres of land meeting these requirements; however, with the growth of hyperscale data centers, many site selectors will look for at least 50-60 acres of land with good connectivity and power. Secondary site selection factors included workforce, specifically a qualified construction workforce, quality of life assets like restaurants and lodging, and connectivity. Industry experts indicated that there is also some consideration given to transportation and proximity to airports for prospective clients. Stakeholders were mixed on the importance of local incentives.

Stakeholders also emphasized the importance of redundancy for both connectivity and power. Technology has helped to mitigate latency issues caused by distance, but it remains a priority, particularly for some specific types of data centers and users (for example, data centers that host financial trades that rely on extreme data speeds). These centers look for speed but also the ability for the network to easily adapt if one transmission route is compromised. Similarly, data centers are looking for multiple modes of power and the ability to withstand a cut in one power source. As such, data centers are adopting several alternative energy sources, supporting their existing goals of becoming net-carbon-neutral. Data centers also tend to avoid areas with perceived vulnerabilities to climate change or other natural disasters or risks.

With these specific requirements, data centers often gravitate to locations with existing clusters, such as in Northern Virginia. However, with increasing land prices and market saturation, data centers are now gravitating to secondary data center markets that may have similar resources. Data centers are aware of the internet, power and other infrastructure already present. Moreover, companies also know that an ecosystem of support services already exists in the region. For instance, several industry informants and stakeholders described how contractors in Northern and Central Virginia already have expertise in building data centers to appropriate specifications. Other supply-chain firms supporting HVAC, fiber, and power are present in these areas and are familiar with the specific needs of data centers. Northern Virginia Community College also has training and degree programs specifically for data centers with strong career pathways for students. Many data centers hire students even before they

graduate from the program. Research conducted during this study suggests a naturally emerging trend of data center industry growth expanding south of the Northern Virginia region, providing opportunity for well-positioned localities that may have similar resources and infrastructure.

The regulatory climate of the state and its localities has become ever more important for keeping Virginia competitive with other states. Like many other industries, data centers prioritize speed of development and regulatory consistency. They are looking for an easy regulatory environment that does not prolong their construction and entrance into a market. Communities that offer "fast track" processes and concierge service to a data center tend to be more successful in attracting firms. Communities that may exhibit political uncertainty and frequent regulatory changes, such as inconsistent zoning policies, may be less likely to attract and retain data centers. Many industry interview participants also indicated the importance of stable tax structure as part of the overall business climate in a prospective locality.

Appendix A: Methodological Notes

In addition to reviewing and gathering industry data to examine state and national trends, university partners conducted interviews and focus groups with over 20 industry experts, data centers representatives, and local and state economic developers. To assess the impact of data centers on the Commonwealth, including tax revenue and upstream-downstream industry impacts, university partners used a combination of reviewing recent relevant studies and assessing secondary data on industry interactions related to data centers.

Value Chain and Impacts Analysis

In assessing the value chain for data centers, we used information available from industry publications, insights gathered in stakeholder interviews, and data estimating inter-industry transactions. The inter-industry transactions data are sourced from IMPLAN and reflect their modeling adaptation of benchmark input-output matrices developed by the U.S. Bureau of Economic Analysis. These data show the industries that contribute equipment, supplies, and services to data center operators, what is commonly called the industry's value chain. The analysis also considered the downstream side of the industry which describes the industries and households that consumer the services of data centers. In this case, we think of data storage services as a "commodity" that is consumed by end users or as an intermediate input to the production of other goods and services – such as support for streaming video services. As described in the body of the report, a key limitation to this research approach is that data centers are one component of an aggregated industry sector that includes some services whose patterns of consumption and production may be different from data center operations. However, such deviations can be readily addressed through input from knowledgeable stakeholders. Our purpose here is not to specify dollar values of industry interactions in this task, but rather to identify industry clusters and cluster development opportunities.

The Northern Virginia Technology Council has commissioned multiple analyses of the economic and fiscal contributions of Virginia's data center industry over the past several years. The research is performed by Virginia-based Mangum Economics, LLC. The most recent report, published in July 2022, uses 2021 data gathered from many of the same sources used in this analysis, and is the most recent data available. Importantly, the Mangum team clearly describe their data sources, methods, and assumptions in that report and in an in-depth interaction with members of the university team. The economic analysis in the NVTC report uses the IMPLAN model and is the most widely used, commercially available input-output model in the market. The university team has collectively performed hundreds of analyses using the IMPLAN model. Given data and methodological similarities, and based on our conclusion that the Mangum analysis used sound methods and appropriately conservative assumptions, the university team did not duplicate the NVTC study. We did test selected elements of their analysis and are comfortable in adopting the findings of the NVTC study into this report.

Interviews and Focus Groups

The following is the interview protocol used with data center stakeholders. University partners conducted 15 interviews and three focus groups. In each instance, at least two researchers represented the university partners, one leading the interview and another taking notes. In several instances, more than two university partners were present and VEDP representatives were all present.

Interview Goals: Gather input/information on the following topics—

- How technology is changing data center facilities/infrastructure/labor requirements
- Long-term predictions, future of industry, future demand
- Incentives and assets contributing to location decisions
- "Other" impacts of data centers (social, educational, other)

Important Note: The purpose of this protocol is to supply a framework for discussions. It is not intended that the questions be asked in strict linear fashion. Let the conversation evolve, interjecting key questions as appropriate to gather the information sought. Not all questions may be relevant.

Introduction and Statement of Purpose

"Thank you for agreeing to meet with us. We are faculty in the Strome College of Business at Old Dominion University working with the Dragas Center for Economic Analysis and Policy on a Virginia Economic Development Partnership-sponsored project to assess the usefulness of economic development incentives to companies like yours.

This study will assist the Virginia Economic Development Partnership in refining economic development incentives and other business assistance programs to better serve the state's economic development goals related to job creation and economic development.

Any information you provide will be treated as confidential. Findings from this research will only be reported in aggregate form. However, we might later ask you if we can identify your company to illustrate important points or even quote you on some of your insights and suggestions.

We don't want to take up a lot of your time, and in general, it will take about 30-45 minutes to run through some of the questions we have today."

Data Center Questions

- Please briefly describe how your firm goes about selecting data center site locations. What key factors do you consider?
    - Are there general **market conditions** you look for in a site (e.g., population size, proximity to markets, land price)

    - Are there **utility requirements** such as electric power availability/pricing or water-cooling capacity/pricing?
    - Are there **other industries** that you want to be near or want to avoid?
    - What role does the **workforce** play in site choice? What are your desirable labor market characteristics (specific degrees, % with degrees, wage rates, unemployment)
- How important are tax rates to your site location decision?
    - Do you look specifically at property or sales taxes, or do you decide based on overall tax burden?
    - What do you look for in a tax structure? (e.g., stability, machine and tools taxes, etc.)
- What state and local incentives did you receive in Virginia?
    - If monetary incentives, how would you characterize the balance between local and state money received by your company (90-10, 75-25, 50-50, other)
    - Any non-monetary incentives?
        - Workforce: Training/Internships
        - Regulatory issues
        - Facilities/infrastructure
        - Utility services
        - Expansion assistance
        - Business recruitment
        - Other economic incentives
- Let's compare Virginia with neighboring states such as Georgia, South Carolina, North Carolina, Maryland, and Tennessee...
    - What impressions do you have of the business environment for data centers in these states?
    - How would you characterize the business environment for data centers in Virginia compared to these states?
    - What characteristics make the business environment more (less) favorable in (state) compared to Virginia?
    - What incentives are other states (or localities in those states) offering that Virginia should consider?
- Do you foresee keeping this data center in _____? Why?
    - Does the data center own the building, or does it lease space in the building? If lease, how long is the lease?
    - What would attract you away from this region in the future? Specific incentives and regional assets?
- What other regional industries or businesses do you see being positively affected by the presence of your and other data centers? How are they affected?

- What regional impacts have you seen or heard about that have resulted from the data center coming to the region?
    - Tax revenue
    - Infrastructure development
    - Employment (i.e., are your residents getting jobs or are people commuting in for jobs? Lower unemployment and higher wage jobs?)
    - Population growth
    - Workforce development (e.g., increase in skilled workers, partnerships between data center and educational institutions, new education programs)
    - Research or industry growth in area
    - Other community partnerships that have positively impacted in the area?

Industry Expert Questions

- Please briefly describe how data center firms go about selecting site locations. What key factors do they consider?
    - Are there general **market conditions** you look for in a site (e.g., population size, proximity to markets, land price)
    - Are there **utility requirements** such as electric power availability/pricing or water-cooling capacity/pricing?
    - Are there **other industries** that you want to be near or want to avoid?
    - What roles does the **workforce** play in site choice? What are your desirable labor market characteristics (specific degrees, % with degrees, wage rates, unemployment)
- How important are tax rates to data center site location decisions?
    - Do you look specifically at property or sales taxes, or do you decide based on overall tax burden?
    - What do you look for in a tax structure? (e.g., stability, machine and tools taxes, etc.)
- What state and local incentives seem to be most beneficial for attracting data centers?
    - Taxes
    - Workforce
    - Regulatory issues
    - Facilities/infrastructure
    - Utility services
    - Expansion assistance
    - Business recruitment
    - Other economic incentives

- Let's compare Virginia with neighboring states such as Georgia, South Carolina, North Carolina, Maryland, and Tennessee...
    - What impressions do you have of the business environment for data centers in these states?
    - How would you characterize the business environment for data centers in Virginia compared to these states?
    - What characteristics make the business environment more (less) favorable in (state) compared to Virginia?
    - What incentives are other states (or localities in those states) offering that Virginia should consider?
- What other regional industries or businesses do you see being positively affected by the presence of data centers? How are they affected?
- What regional impacts have you seen or heard about that have resulted from a data center coming to a region?
    - New building projects post-data center establishment
    - Tax revenue
    - Infrastructure development
    - Employment (i.e., are your residents getting jobs or are people commuting in for jobs? Lower unemployment and higher wage jobs?)
    - Population growth
    - Workforce development (e.g., increase in skilled workers, partnerships between data center and educational institutions, new education programs)
    - Research or industry growth in area
    - Community partners (offering cloud space; personnel on nonprofit boards; etc.)
- Who are your most significant business partnerships in your region?

Economic Development and Workforce Development Questions

- How many data centers are in your county/region?
- Why has your locality/region targeted the data center industry as a growth industry?
- What incentives have you used to market your locality/region for data centers?
    - What incentives have you found to be successful in attracting or at least gaining the attention of data center prospects?
    - What incentives have you seen or examined but not used in your economic development efforts? Why?
- What other assets have you used to attract data centers and how successful were those factors?
    - Market conditions (population, proximity to markets, land price)
    - Utility requirements
    - Workforce
    - Proximity to other industries

- What have been the impacts of having one or more data centers in your locality/region?
    - What benefits have you seen with respect to…
        - Tax revenue
        - Infrastructure development
        - Employment (i.e., are your residents getting jobs or are people commuting in for jobs? Lower unemployment and higher wage jobs?)
        - Population growth
        - Workforce development (e.g., increase in skilled workers, partnerships between data center and educational institutions, new education programs)
        - Research or industry growth in area
        - Other community partnerships that have positively impacted the area?
    - What challenges have you experienced by having a data center in your locality/region?

General Questions (all interviews)

- In general, how would you characterize the data center industry in Virginia?
- What trends have you witnessed in Virginia?
    - What do you imagine the future of the industry being for Virginia?
    - Please describe how technology in the industry has changed and how that might affect the industry in the future. For instance, air-cooled servers and the speed at which technology needs replacing.
- Do you see any opportunities for industry growth in Virginia?
    - What are prospects for data center growth in regions outside of northern Virginia? More rural region of the state?
- What might be some of the challenges?

Upon completion of interviews, university partners combined and reviewed all interview notes. Several stakeholders interviewed also provided documents from their firms, including models for calculating site selection, impact stories, and site readiness criteria. University partners then reviewed all interview notes, highlighting key themes that emerged from the interviews.

Appendix B: Importance of State Incentives and Site Decisions

A significant portion of Virginia's economic investments comes from data centers. In 2021, 62% of all new investments announced by the Virginia Economic Development Partnership (VEDP) resulted from new and expanding data centers. To attract business growth in the state, Virginia offers the Virginia Data Center program—a sales and use tax exemption on equipment that meets certain qualifications. In general, this incentive requires new capital investment of $150 million that results in a minimum of 50 new jobs in a local community of the state. To stimulate economic growth in distressed communities, the minimum new job requirement is reduced to 25 new jobs if a data center locates in an enterprise zone. In addition, there is a minimum wage requirement of the data center incentive program—each new job must pay 150% of the annual average wage in the community of the data center. Colocation data centers could also qualify for the sales and use tax exemption. Given that the Virginia data center incentive program is set to expire in 2035, policymaker might find it useful to know how effective this program is in attracting data centers to locate or expand in Virginia. This assessment will review selected previous research on the effectiveness of state incentive programs along with a brief review of the recent Joint Legislative Audit and Review Commission's Evaluation of the Data Center Incentive.

To address the question of the effectiveness of state level incentive programs, a review of the research literature can provide guidance and insight into the most appropriate data and methods for conducting evaluations. This assessment provides a review of previous research on the effectiveness of state incentive programs.

For at least the past 30 years, economic studies on the effectiveness of state and local tax incentive programs on business location decisions have produced mixed results.[xxxv] The economic development literature identifies the factors that motivate firms to relocate, and the factors that weigh into their location choices. According to this literature, firms cite a range of reasons for seeking a new location—cost savings, consolidation of operations, accommodation of business growth or decline, self-interest, and proximity to relevant networks.[xxxvi] Other factors in location decisions include transportation infrastructure, site/building quality, property costs, and quality of available workforce.[xxxvii] The most frequently cited reason for a firm's location decision is profit maximization.[xxxviii] A firm's location decision often follows a general process where alternatives are weighed based on certain criteria. Firms and sight selection consultants typically start with a larger group of communities and then narrow their choices to a smaller set of communities where site visits are conducted, and detailed information is collected. Accordingly, to be competitive in attracting firms, states must be actively involved with prospective firms as they seek the appropriate information in their decision process. An understanding of the factors that are most important for firms seeking location is essential for states to provide relevant, attractive, timely and appropriate information.

The economic development literature also details the controversial nature of state incentive programs. The idea of "picking winners" is one controversy. Questions about politics emerge because while some firms or industries receive incentives, others do not. Additional questions about the relative benefits over costs are also raised.

Some scholars have raised concerns over whether incentives are more likely to go to mega corporations than to small firms. Jensen & Malesky suggest that high-profile incentives can be influential in elections because of the importance of creating job opportunities.[xxxix] In their recent study, Slattery and Zidar found that: "more than 30% of all establishments with over 1,000 employees receive discretionary subsidies, while this percentage is less 0.2% for establishments under 250 employees."[xl] It remains unclear to some scholars whether it is consistent with the public interest to provide incentives to firms such as Amazon given their market power.

The fact that the costs of incentives are increasing is another controversy raised by scholars. In his 2017 review, Bartik examined state and local government incentives from 1990 to 2015 and found that they had tripled. He notes that the intensity of state competition for firm locations may have increased over this time frame. Some examples include the Foxconn incentive, assessed to be more than 10 times the typical incentive in the U.S.[xli]; the Amazon "Headquarters 2" project assessed at 10 times the usual incentive per job[xlii]; and the incentives received by other large firms in the hundreds of thousands of dollars per job.[xliii]

Some scholars have posed the question of whether the trade-offs of expanding incentives can be justified by the benefits. Concerns about reducing public services and raising household taxes to cover the cost of expanding incentives beyond their current levels. Bartik suggests that the costs of incentives could be justified if the benefits of jobs created outweigh the costs of the incentives; if earning increase among residents in both the short and long run; or if social problems such as drug abuse are offset by improvement in job skills.[xliv]

To set the stage for this assessment of what we know about the effectiveness of state tax incentive programs, a review of some of the methodological and data issues will be provided. In his 1991 review, Bartik detailed five categories of challenges with economic studies of the effects of state and local incentives on economic development.

The first challenge identified by Bartik is the difficulty of modeling complex individual firm decisions using aggregate data. While he acknowledges that regional economic growth results from individual firm location or expansion decisions, and that these individual decisions contribute to aggregate measures of growth, he questions whether aggregate statistics are a good proxy to model individual firm behavior. According to Bartik, far too many studies assume that aggregate statistics are a suitable proxy.[xlv]

While the economic development literature identifies profit maximization as the primary impetus to seek a new location, it also reveals that the factors that affect the ultimate site selection are complex. Some scholars have labeled these factors as tangible or intangible[xlvi], or

as cost and non-cost[xlvii]. All in all, location factors involve a complex mix of primary factors, such as location in relation to markets, material sources, transportation cost and services, availability and cost of utilities, availability and cost of labor, labor quality, and location costs. In addition, there are secondary factors including the availability and cost of materials, state and local tax structure, legislation affecting industry, business climate, weather, availability of financial assistance, location relative to competitors or to other facilities of the company. Additional factors considered by firms and site selection teams are labor-management relations, labor training programs, the street and highway network, the electricity power supply, natural gas cost and services, water supply and services, telecommunication services, educational resources, population, labor, water, power, fuel, markets, topography, land, and buildings.[xlviii]

A second challenge identified by Bartik is the role that past economic performance plays in shaping current economic conditions. While he believes that economic studies of the effects of incentives should control for past economic conditions, many of them simply do not.

A third challenge cited by Bartik is the arduous task of measuring the key influences on economic development. His review specifies three factors: wages, public services, and taxes. He notes that while wages are typically measured on average, this measure fails to control for labor quality, He suggests that a well-crafted study should control for labor quality with the use of an education measure. The importance of considering both sides of the state and local fiscal matters shape business decisions. On the one hand, it is tax minimization is important, while on the other hand, businesses are attracted by high quality public services. He notes that inadequate public services can hamper economic development. He advises that at least one public service variable should be included in economic studies of incentives. In addition, he highlights the weakness of state and local tax data, citing that the available data is insufficient for cross jurisdictional and cross industry comparisons.

Bartik identifies a fourth challenge as the difficulty of controlling for every factor that affects business decision-making. In addition to the tangle factors previously discussed, there are intangible factors that are important to firms, such as educational resources, housing and quality of life issues, public services such as fire, police and emergency, recreational activities, and community values. The measurement of intangible factors is inherently difficult, and are often excluded from models, resulting in attributing influential effects to taxes that are due to the omitted variables that correlate with them. The importance of controlling for “fixed effects” with the inclusion of dummy variables or other reasonable techniques is suggested by Bartik to minimize this problem.

Complicating matters even further is the difficulty in aligning a firm’s stated preferences with their final choice[xlix]. In their study of locational choices, Barkley and McNamara found that even when firms revealed that they valued certain factors, they often chose a location that compromised the integrity of them, suggesting that tradeoffs are made. Additional findings of this study revealed that firm behavior coincided with factors that were readily observable. This study seemed to suggest that some variables are far more influential than others. Areas that

were above average in "population, growth rates, median income, wage rates, educational levels and government expenditures per capita" were selected more frequently; while counties with "low quality schools or public services" were less often chosen for firm location sites.[l]

A final problem revealed by Bartik is the issue of feedback between the control variables and the growth variable, otherwise referred to as the use of endogenous independent variables. He provides the example of the confounding statistical relationship between wages and economic growth, suggesting a relationship whereby lower wages promote growth, while higher economic growth results in higher wages. To overcome this challenge, he suggests using instrumental variables that control for endogenous relationships.

Taken together, the issues identified by Bartik provide insight into the difficulty of synthesizing the results across the range of studies of the effectiveness of state level incentive programs. All studies are unique. The literature on the relationship between incentives and economic development is broad, and this makes it challenging to synthesize the results of the empirical research. The studies comprising this body of literature vary with respect to methodology, economic growth measures, data sources, time periods of analysis, and non-tax factors considered in the models as potentially influential in determining economic growth. Considering his three decades of research on the complexity of relationship between taxes and economic development, it should come as little surprise that Bartik has developed an approach to conducting a meta-analysis to uncover what the empirical research reveals about the effects of incentive programs on the probability of firms making a location, expansion, or retention decision in favor of a given state or local area.

Meta-Analysis and Meta-Regression Analysis

A reasonable approach to review the empirical research literature on the effectiveness of state tax incentive programs is meta-analysis—a statistical analysis of research findings through a synthesis of many empirical studies. This approach is more commonly used in the fields of psychology, education, and the health sciences to obtain an overall test of the magnitude of the relationship under investigation by a collection of studies along with the assessment of the strength of the statistical relationship. Meta-analysis is an empirical technique that uses data points from individual studies instead of using individual observations from a unique data source. It is considered to be more rigorous than the typical casual, narrative discussion of research.

Economic studies tend to exclude the use of meta-analysis for a couple of reasons. The first involves their heavy reliance on regression analysis for their hypothesis testing—contrarily meta-analysis techniques make use of empirical results from other statistical methodologies. The second involves the criticisms levied on meta-analysis, including the variability in methods used in the original studies; the mixing of poorly designed studies with well-designed studies; the publication bias toward studies that reject the null hypothesis; the use of multiple results from a single study thereby inappropriately increasing its influence; and the masking of

moderating variables. Meta-Regression Analysis (MRA) is offered a technique for summarizing regression results across studies and to help address the problems identified above.

MRA Model to Review the Literature on the Effectiveness of State Tax Incentives

In his 2018 study Bartik estimated "but for" percentages from 30 of 34 different studies he surveyed that examined the effect of taxes on economic development. "But-for" percentages was defined as "the probability of firms making a location, expansion, or retention decision in favor of a particular state or local area."[li] The central aim of this work was to identify the percentage of cases where a location decision would not have been made "but for" the incentive.

Bartik considered whether studies assessed the effects of incentives in a single state, whether they compared jurisdictional variation in the utilization of incentives with a single state, and whether they used data from multiple states. Using a regression meta-analysis of 34 estimates, Bartik performed a regression of the "but for" percentage to produce an overall estimate of the effect size.

Bartik found that a reasonable range for the incentive "but for" percentage was 2 to 25 percent. This means that in a typical state and local incentive package, "in only 2 to 25 percent of the incented projects is the incentive decisive in tipping a location, expansion, or job retention decision towards that state or local area. In the other 75 to 98 percent of the time, the same decision would have been made without the incentive.[lii]

As a result of this analysis, the costs and benefits can be described as follows: according to recent research on the effect of state and local business taxes on business location decisions and local job growth, a 20% reduction in business taxes, holding public services constant, increases business activity by 10%.[liii] Bartik adds that since state and local taxes are about 5% of business value added, if business taxes were cut by 1% of business value added (20% of the 5%) should increase business activity by roughly 10%. If incentives operate in the same manner as tax cuts, an incentive of 1% of value added should increase business activity by 10%. Correspondingly, offering an incentive to a firm faced with the decision of locating a facility should tip the decision 10% of the time.[liv]

Comparison to prior Research

Bartik provides a comparison of his "but for" range of 2-15 percent for US incentives to the extensive research literature on the effects of state and local business taxes on business location decisions and found his estimate to be consistent with prior studies which range in probabilities as low as 1 percent to as high as 21 percent.[lv]

In its 2019 Evaluation of the Data Center Incentive, the Joint Legislative Audit and Review Commission (JLARC) found a "but-for" percentage of 90%, suggesting that in 90 percent of the cases where a firm received the sale and use tax exemption the incented project was tipped by the incentive. This estimate exceeds the average incentives tip by about 80%.[lvi] This

analysis does not try to establish empirical causation between specific industry characteristics and the relative importance of incentives in their site selection process, we can observe that the capital refresh rate, as noted elsewhere in this report, is substantially higher for data centers compared to traditional industry sectors.

Appendix C: Trends and Incentives from Other States

Because of industry growth and net fiscal benefits described in previous sections, a majority of U.S. states and many localities are including the attraction of data centers as an industry for targeted economic development programming. Our discussions with economic development practitioners and a desk review of legislation in key states, indicate that more than 30 states have some form of incentive that targets data center development or is applicable for data centers. As described elsewhere in this report, the availability of incentives that support capital investments in data centers is increasingly a necessary condition for most site location decisions. As noted in the JLARC report, over 90% of the data centers in Virginia would not likely have located here absent the Commonwealth's targeted sales tax exemption.

There is rising concern, expressed by all of our key informants in this research, that the sunset date for the Virginia sales tax exemption for qualifying data center investments is a concern for data center developers and operators. The current Virginia program will automatically sunset in 2035, and while that date is more than a decade away, it is creating uncertainty among developers about the risks of Virginia's future taxing regime, especially given the industry's equipment re-fresh rate. Data center servers typically receive major upgrades every three to five years – so over time, there are repeated major capital investments, even if the there are no physical expansions at a data center. Simply put, every few years data center managers and developers make a choice of where to make capital investments, relocating that investment to a different state is an increasingly viable option as more states a) see data centers develop and b) have perceived reliability in their incentive offerings. Also, as more companies shift to cloud solutions in software and data storage, demand for data center capacity is causing developers to increasingly move towards hyperscale data centers that represent investments upwards of $10 billion. Clearly, the investment horizon for multi-billion dollar investments becomes longer and the potential loss of incentives due to sunset provisions are becoming a bigger issue in site selection decisions.

The competitive landscape for state incentives for data centers is constantly changing. The number of states with targeted incentives is growing and many of these states have chosen to not have sunset provisions in their policymaking, making the choice that state legislatures *always* have the authority to rescind an incentive policy every time they are in session. Some states that do not have data center specific incentive programs are still potentially very competitive because of broader incentive or state taxing policies. For example, Oregon and Montana are both seeing notable investments in data centers; neither of these states have sales and use taxes. Also, many states offer sales and use tax exemptions for businesses that locate in economic distressed areas. Finally, some states, such as West Virginia, are expanding existing sales tax exemptions for manufacturing equipment, which is a very common

incentive across U.S. states, purchases to data center equipment purchases. This results in a highly diverse set of policies that impact state competition for data center investments. The key point, the results of our interactions with key informants is that Virginia is facing increasingly intense competition for data center investments and the current sunset provision of the existing sales tax exemption program is boosting the prospects of the Commonwealth's competitors.

An expanded table highlighting key findings of our review of state level incentive programs targeting data center development is available in a separate document. Instead of having a legislative sunset on their incentive programs, many states have chosen to limit the number of years a given incentive recipient can receive an incentive. This is a holdover of traditional property tax abatement incentives that are granted for a specified number of years based on qualifying capital investments and/or job creation commitments. However, these programs almost always either explicitly allow or do not block the extension of these tax abatements either through the recipient re-applying for the incentive or the incentive being extended as a part of business retention strategies. Given the comparatively frequent refresh of data center capital investments, it seems that incentive programs with time limits are practically permanent in nature, ending only when a state legislature chooses to alter state policies.

Table 1. Selected State Incentives Targeting Data Center Investments

State	Sunset Date	Time Limit (yrs)	Incentive	Capital-Ex/Jobs Investment	Notes
VIRGINIA	2035		Sales tax exemption	$150M/50	Lower requirements in distressed areas. Wages 150% avg
ALABAMA		30	Reduced sales tax rate, property tax abatement	$400M/20	Avg wage $40,000
ARIZONA	2033	10/20	Sales and use tax exemption	$25M-$50M in 5 yrs	Higher limit in Maricopa & Pima counties
DELWARE			No sales tax		Not DC specific
FLORIDA	2027		Sales tax and use tax for data centers, infrastructure, equipment, personal property, and electricity	$150M	

State	Sunset Date	Time Limit (yrs)	Incentive	Capital-Ex/Jobs Investment	Notes
GEORGIA[1]	2031	n/a	Sales and use tax exemption	$25m-$250/20	Vary by local population
IDAHO[2]	n/a	n/a	Sales tax exemption	$250M/30 jobs	
INDIANA		25/50	Sales tax exemption	$750M or less	>$750M for 50yr
IOWA			Sales tax exemption, no property tax on equipment	$1M min, more for $200M+	
KANSAS[3]			No property tax on new equipment		Not DC specific
KENTUCKY[4] **(Pending)**		30	No property tax on equipment	If county pop. <100k then $150M/20, if county pop >100k then $300M/50	Bill introduced to House Floor 2/28/22
LOUISIANA[5]	n/a	10	Up to a 6 percent rebate on annual payroll expenses for up to 10 years and either a state sales/use tax rebate on capital expense or a 1.5 percent project facility expense rebate for qualifying expenses		Not DC specific

[1] https://dor.georgia.gov/sales-tax-rule-560-12-2-117-high-technology-data-center-equipment
[2] https://commerce.idaho.gov/incentives-and-financing/incentives/data-center-sales-tax-exemption/#:~:text=Beginning%20July%201%2C%202020%2C%20new,through%20the%20Idaho%20Tax%20Commission.
[3] https://www.ksrevenue.gov/prtaxincentives-proptaxabate.html#:~:text=A%20property%20tax%20exemption%20exists%20for%20low%2Ddollar%20items%20of,subject%20to%20Kansas%20income%20tax.
[4] https://apps.legislature.ky.gov/record/22rs/hb379.html#HFA1
[5] https://www.opportunitylouisiana.gov/business-incentives/quality-jobs

State	Sunset Date	Time Limit (yrs)	Incentive	Capital-Ex/Jobs Investment	Notes
MARYLAND		10/20		$2M-$5M /5 $250M over 10 yrs	150% state min wage "net new" to MD
MICHIGAN[6]	2035	n/a	Exempt the sale, use, or consumption of data center equipment from sales and use tax	n/a	Exemption only continues after 2026 until the state has 1,000 data center or related industry jobs
MINNESOTA		20	Sales exemption - equipment and energy. PERMANENT personal property tax exemption	$50M/50	150% avg state wage
MISSISSPPI		10	Income, franchise, sales and use tax exemptions	$20M/20	125% avg state wage
MISSOURI		15	Sales and use tax exemption	$25M/10	Well-paying
NEBRASKA			Sales and use tax exemption on tangible property & services		
NEVADA		10/20	75% Business Personal Property (BPP) abatement, sales and use tax reduction (2%)	$25M/10 $100M/50	State avg wage, contribute to med insurance
NEW MEXICO[7]	n/a	100% first 15 yrs, 67% 16th yr, 33% for 17th yr	Property tax abatement for an existing or new data center	$25M	Introduced to House in 2018, no further action taken

[6] https://www.michigan.gov/treasury/reference/taxpayer-notices/notice-report-for-qualified-data-center-exemptions-form-5726

[7] https://www.nmlegis.gov/(X(1)S(rhnmeu4ptfmq2pfma5pqprlk))/Legislation/Legislation?chamber=H&legtype=B&legno=324&year=18&AspxAutoDetectCookieSupport=1

State	Sunset Date	Time Limit (yrs)	Incentive	Capital-Ex/Jobs Investment	Notes
NEW YORK[8]	n/a	n/a	Sales and use tax exemption on equipment and selected services	n/a	Only for internet data centers
NORTH CAROLINA			Sales tax exemptions (electricity & equipment), some BPP	$75M/$250M	Local wage levels, health insurance
NORTH DAKOTA			Sales tax exemption for IT equipment and software		50%+ of bldg area used for data processing
OHIO		Max to date: 40 yrs	Authorizes full or partial exemption of sales and use taxes.	$100M	Annual payroll $1.5M+
OKLAHOMA[9]	n/a	5 for ad valorem tax exemption	1. Ad valorem tax exemption for computer services and processing 2. Computer services and data processing sales tax exemption 3. Data processing sales tax refund	$500k for ad valorem exemption, 10 jobs for data processing sales tax refund	
OREGON[10]	n/a	3 to 5 years	No sales tax in the state, enterprise zone program offers property taxes	$100M or $25M in rural/5 jobs	Program not targeted for DCs but still utilized for DCs
PENNSYLVANIA[11]	n/a	n/a	Sales and use tax exemption	$75M is county pop. <250k and creates 25 jobs, $100M if county pop >250k and creates 45 jobs	

[8] https://www.tax.ny.gov/pubs_and_bulls/tg_bulletins/st/internet_data_centers.htm
[9] https://www.okcommerce.gov/wp-content/uploads/Oklahoma-Business-Incentives-and-Tax-Guide.pdf
[10] https://www.stackinfra.com/wp-content/uploads/2021/02/Portland_Tax_Incentives_022421.pdf
[11] https://www.revenue.pa.gov/IncentivesCreditsPrograms/ComputerDataCenterEquipProg/Documents/computer_data_center_equip_exemption_program_guidelines.pdf

State	Sunset Date	Time Limit (yrs)	Incentive	Capital-Ex/Jobs Investment	Notes
SOUTH CAROLINA	Change rule 1/1/2032	10 yr after 2032	Sales and use tax exemption equip and software	$50M/25 (old) $75M/0 (new)	New 150% of area PCI
TENNESSEE			1.5% reduced sales tax rate on electricity	$100M/15	150% state avg wage w health insurance
TEXAS		2010	Sales and use tax exemption	$200M-$250M/ 20	120% avg wages, 1,820 hours, continuous for 5 years
UTAH[12]	n/a	n/a	Sales tax exemption	n/a	Facility must be >150,000 sq ft
WASHINGTON[13]	2036 for urban, 2048 for rural	n/a	Sales and use tax exemption	Urban: net employment increase 3 family wage jobs per 20,000 sqft Rural: lesser of 35 family wage jobs or 3 family wages jobs per 20,000 sqft	Urban: max 6 certificates per year until 2027
WEST VIRGINIA	Mix of programs		BPP 5% of cost, sales tax exemption (equip, software, bldg. materials)		
WYOMING			Sales tax exemption	$5M-$50M/ Variable Job	# of jobs set by WY Bus. Council

[12] https://le.utah.gov/~2016s3/bills/static/sb3002.html
[13] https://dor.wa.gov/taxes-rates/tax-incentives/tax-incentive-programs#1575

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[viii] Vec, QCEW 1990 Q1 - 2021 Q4 * Used NAICS 518210 – Data Processing, Hosting, and Related Services. This categorization does not completely capture all data center employment. Some relevant jobs were also categorized under other NAICS such as 541511 – Custom Computer Programming Services. VEDP staff reviewed employment data to provide the most accurate estimate possible.

[ix] VEC, QCEW 1990 Q1 – 2021 Q4

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[xxiii] The research team gratefully acknowledges the cooperation and information provided by Fletcher Mangum and his staff in reviewing their analysis.

[xxiv] Virginia Code § 58.1-609.3 enacted in 2022 requires VEDP to capture more detail data on data center industry trends.
[xxv] The analysis performed in the JLARC study used a different methodology. That analysis used a hybrid general equilibrium/input-output model developed by REMI.
[xxvi] The NVTC analysis reports that Virginia would have to send Loudoun County and Prince William County schools $90.5 million in funding off-set revenues if data centers did not exist in those jurisdictions.

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