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Other Data Center Economic Impact Studies	
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4	The Impact of Data Centers on the Arizona Economy, February 2021
5	Data Centers, Jobs and Opportunities in Communities Nationwide, 2017

Potential Impact of a

Data Center Incentive in Illinois

Prepared For: The Illinois Chamber of Commerce Foundation

Report

MANGUM economics

NOVEMBER 2018

Supported by: Illinois Chamber Foundation, Equinix, Digital Realty, QTS, Chicagoland Chamber of Commerce Foundation

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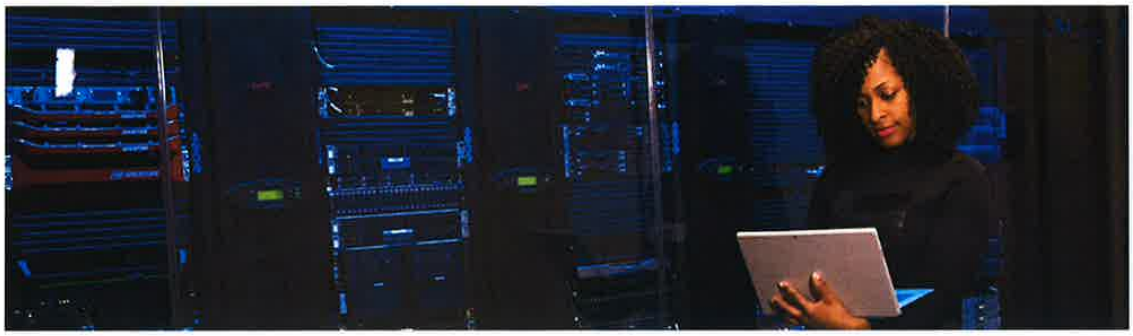

Executive Summary

This report compares the disparity of data center capital investment growth and jobs created between Illinois and neighboring and competitive states and examines the state tax policies used to attract and grow the industry.

In an increasingly digitally-connected world, data centers are critical infrastructure facilities providing for the storage and transmission of data related to financial services, health care, retail, transportation, telecommunications, academia, entertainment, and almost every industry. Additionally, data centers are essential to the functioning of all networked, computer-centric devices, such as smart phones and tablets, and GPS systems. Data centers are part of the core infrastructure that supports the technology sector and constitute the backbone of the modern economy. Nearly every business operates a data center, either in-house or as a contracted service. Data centers are special real estate assets that require multimillion-dollar, up-front capital investments and on-going operating and maintenance costs, as the computer equipment is refreshed on a two- to three-year cycle. As the world's economy continues its reliance upon digital information, the need for facilities to store and transmit the ever-expanding universe of data will continue to grow.

The area around Chicago accounted for 93 percent of employment in Illinois' data center industry. According to CBRE, the Greater Chicago area is the third largest data center market in the United States, but the rest of the state of Illinois has very few data centers. While the Chicago market is large, it is 40 percent smaller than the size of the Northern Virginia market. And it is growing much more slowly than other major markets. According to CBRE, from June 2017 to June 2018, the Chicago data center market grew at a rate of 7 percent. At the same time, the Atlanta market grew 12 percent, the Northern Virginia market grew 16 percent, and the Phoenix market grew 26 percent.

The data center industry's total 2017 economic impact on Illinois was approximately 31,500 jobs, $2.4 billion in labor income, and $7.1 billion in economic output. Illinois data centers generated a total of approximately $877.5 million in tax revenue in 2017, of which $321.7 million was state and local tax revenue.[1] Construction expenditures for new data centers in Illinois were $122.3 million in 2017, including $54.1 million in labor income for 820 construction workers.

[1] It is important to realize that this $321.7 million estimate of state and local taxes paid by the data center industry in 2017 is comprised of all state and local taxes paid by the industry. As such, it would include all government revenue from property taxes, sales taxes, corporate income taxes, electricity excise taxes, license fees, and all other applicable taxes at both the state and the local levels. Data to disaggregate this overall state and local tax estimate is not available.

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Illinois showed significantly weaker growth in data center markets than any of the surrounding states that have data center incentives. The data center markets in the state of Illinois beyond the Chicago area have not been doing as well as the markets in surrounding states that have data center incentives.

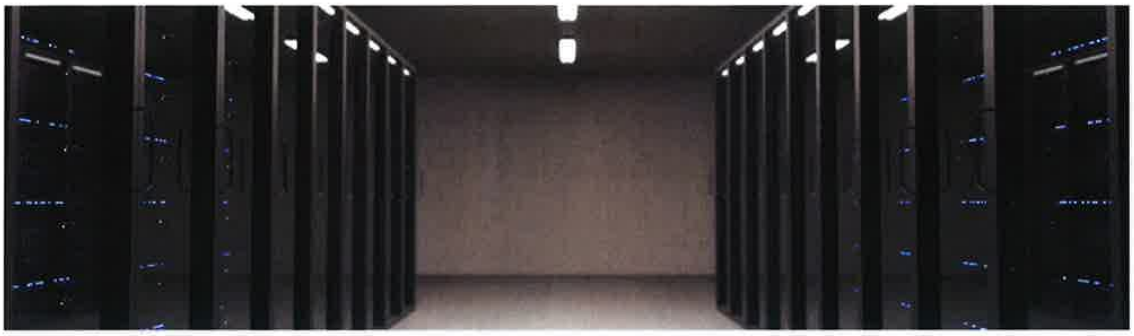
The data center industry in Illinois under-performs the nationwide trends for the data center industry in terms of growth in employment and wages.

In addition to providing capital improvements that add to Illinois' tax base, this capital investment also fuels an on-going demand for data center construction which often uses union labor. This has particular relevance for Illinois, where employment growth in the state's construction sector has lagged behind the national norm in recent years.

Today, 30 states (from Washington to Florida, New York to Arizona) have incentives that are specifically targeted at attracting data centers as part of expanded economic development efforts. However, 24 of these states have enacted legislation since 2012 in an effort to capture a greater percentage of the growth. Illinois is surrounded by states that offer data center incentives.

If a large data center were to be located in Illinois like the one that Apple is building in Waukee, Iowa, the potential total economic impact on the Illinois' statewide economy would be approximately 3,360 jobs, $203.9 million in labor income, and $521.7 million in economic output. That much economic activity would generate approximately $66.7 million in tax revenue, of which $20.2 million would be state and local tax revenue.

Hammond, Indiana was selected as the site for a new data center because of its proximity to Chicago and the "tax-friendliness" of Indiana. It could be a harbinger of more data center development on the significant amount of underutilized property in Hammond, East Chicago, and Gary, Indiana. Significant data center development in the Indiana suburbs of Chicago would likely slow growth in Illinois, especially in the Chicago suburbs.



Industry Trends

There are many ways to define data centers. For practical purposes, a data center is any building that contains networked computer equipment that stores, processes, or distributes large amounts of data. There are also many different business models in the data center industry. For simplicity we can divide them into enterprise data centers and colocation data centers.

Enterprise data centers are constructed, maintained, and operated by one enterprise for the data needs of only one company. They may be built and managed by the same company that houses its data there, or they may be built or managed by one firm to serve one other firm. (This latter type is often referred to as a wholesale or managed hosting data center.) Think of enterprise data centers as detached single-family homes for data centers. The enterprise data centers that receive the most attention store the data of the giant IT companies that are household names. However, other very large data centers serve lesser-known companies, like telecommunications, biotechnology, or insurance companies. Enterprise data centers serve companies who are in a line of business other than hosting data.

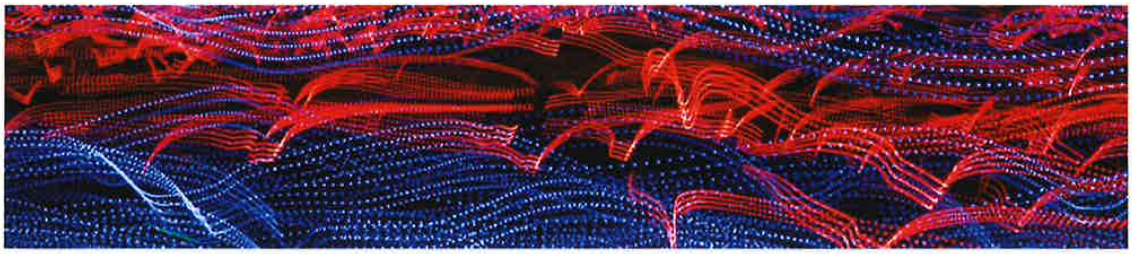
Colocation data centers are usually large buildings that serve multiple business tenants, including giant IT companies. Think of them like shopping malls for data centers. The colocation company rents out its data center space to multiple companies who co-locate their data inside sharing some common building components. Storing data is the primary line of business of colocation data center companies.

Additional information related to this section is provided in the Appendix.

DATA CENTERS AND THE MODERN ECONOMY

Ninety percent of the data stored today was created in the last two years.[2] That statistic is not a static estimate, but the result of an increasingly connected, electronic world. The trend is expected to continue and even increase as more and more connected devices roll out in the internet of things, autonomous vehicles, and as artificial intelligence is increasingly employed to get productive value out of the accumulated data.

[2] IBM, 10 Key Marketing Trends for 2017 and Ideas for Exceeding Customer Expectations.



Smart city technologies will depend on access to large amounts of real-time and historical data from connected devices of various types to learn behavioral patterns, adjust algorithms, and efficiently allocate municipal resources. The volume of data needed for this is startling. For example, just one of Google's self-driving automobile generates one gigabyte of data for every second of operation, totaling two petabytes per year per vehicle.[3] That data along with data from manually controlled vehicles will not remain on the vehicle or only locally at small edge data centers. Instead, this data on vehicle route, speed, the wear on components, and road conditions will be stored by vehicle manufacturers in large data centers to analyze, adjust, and inform algorithms.

Pharmaceutical and biotechnology companies rely on computer modeling of chemical compounds in drug development based on stored clinical trial data. With telemedicine technologies, patients can transmit their health data to distant medical professionals and receive diagnoses and care in real time. All of this health-related data needs to be stored for analysis, archiving, insurance, and billing purposes.

To reduce the chance that data will be permanently lost, it is often stored redundantly in several diverse locations. Businesses of all types are increasingly moving data from on-premises storage to publicly-provided cloud services.[4] The need for data centers is increasing at a much higher rate than the increase in the capacity of data storage devices. For the foreseeable future, the world will need an increasing number of data centers to maintain data in secure and accessible environments.

THE CHICAGO AND ILLINOIS MARKETS FOR DATA CENTERS

Chicago is one of the most important geographic locations in the internet age. It is the third largest city in the nation and the population of its metropolitan area is more than twice the size of the next nearest area in the Midwest, representing a large volume of consumers, participants, and producers in many online aspects and venues. The high-speed financial trading that occurs downtown with other financial exchanges around the globe provides a high and stable demand for high-end connectivity. When there were only a four network access points for the internet in the United States, one was in Chicago – the only one in the Midwest. Combined with relatively low costs of electricity and few environmental risks, these factors and more have made the City of Chicago and its suburbs a prime location for both giant enterprise and colocation data centers.[5] Most of the major data center companies have multiple facilities in the city or just outside of it. According to CBRE, Chicago is the third largest data center market in the United States with

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[3] Datafloq, "Self-driving Cars Will Create 2 Petabytes Of Data, What Are The Big Data Opportunities For The Car Industry?".
[4] PricewaterhouseCoopers, Enterprise data center buyer survey and interview insights, October 2017.
[5] Data Center Frontier, *Special Report: Chicago Data Center Market*, 2016.

245 MW of electricity capacity.[6] For comparison, ahead of Chicago are Northern Virginia (805.8 MW) and Dallas/Fort Worth (267.8 MW). And just trailing Chicago are the Silicon Valley (234.6 MW) and Phoenix (212.9 MW). However, the Chicago market is growing much more slowly than other major markets. According to CBRE, from June 2017 to June 2018, the Chicago data center market grew at a rate of 7 percent. At the same time, the Atlanta market grew 12 percent, the Northern Virginia market grew 16 percent, and the Phoenix market grew 26 percent.[7]

Outside of Chicago and the suburbs adjacent to O'Hare Airport, the rest of the state of Illinois has very few data centers. In the following sections of the report we will go into this stark contrast of the Chicago area with the rest of the state in more detail and explore what may stimulate growth throughout Illinois.

The same was once true of the data center market in the state of Virginia – until data center incentives were enacted. Prior to Virginia's passage of its data center incentive, data centers were heavily concentrated in Ashburn, Virginia. Ashburn is a small town in a distant suburb of Washington, DC that was another one of the four original network access points of the internet. Data centers were drawn there for many of the same reasons that they are drawn to Chicago – especially connectivity. However, there were no data centers to speak of elsewhere in the state. As we will explain later, shortly after the Virginia General Assembly enacted a data center tax incentive, Microsoft announced its intention to build its Boydton data center campus, the East Coast hub for Microsoft's online services, in Mecklenburg County – one of the most rural areas near the southern edge of the state. In 2010, the facility represented an investment of $499 million in a county with less than 33,000 people. Since that time the campus has been expanded five times for a total investment of almost $2 billion and employing 250 people.[8]

Since that time significant investments in data centers have also occurred

- in parts of Northern Virginia that are distant from the important internet infrastructure in Ashburn,
- on a brownfield location north of Richmond near the center of Virginia, and
- in the Virginia Beach area at the southeastern tip of the state.

All of those locations are places where there were no data centers before. Tax incentives were important parts of the package that local economic development officials used to attract the data center investments in each case.

[6] CBRE, *Data Center Trends Report, H1 2018: Surging Demand from Large Cloud Users Driving Record Absorption*. The greatest restraint on data center capacity is the availability of electricity rather than the square footage of the building. Therefore, the best measure of data center capacity is the amount of available electrical power that the data center has in terms of megawatts (MW).

[7] Calculations using data from CBRE, *Data Center Trends Report, H1 2018: Surging Demand from Large Cloud Users Driving Record Absorption* and CBRE, *Data Center Trends Report, H2 2017: Hybrid IT Solutions Continue to Bring Opportunity to the Data Center Industry*.

[8] Richmond Times Dispatch, "Microsoft announces fifth expansion to data center in Mecklenburg County, creating 44 jobs," November 9, 2016.

ILLINOIS (BEYOND CHICAGO) AND SURROUNDING STATES

Before we consider the data center market in the state of Illinois in detail, it is worth comparing the data center markets in Illinois with those in the surrounding states. In doing so we will focus only on the markets in Illinois that are outside of the Chicago area. The data center market of Chicago is not comparable to that of Peoria, Illinois or even that of St. Louis, Missouri. But the data center markets of Peoria and St. Louis are comparable. That is what we do here.

The relative strength of the data center market in Chicago belies the general weakness of the data center market in the rest of Illinois. The easiest way to see the extent of the weakness is to look at how the metropolitan statistical areas in Illinois beyond the Chicago area compare to the metropolitan statistical areas in Missouri, Iowa, Wisconsin, and Indiana in terms of data centers added or lost over time. Figure A uses data on the number of data processing establishments[9] in the standard metropolitan statistical areas in Illinois and surrounding states.[10] We use the time period of 2004 to 2017 because that is the longest period of time for which a meaningful amount of data is reported for the industry.

Several things stand out from the map. Indiana shows only growth or at the very least stability. Over the time period, the data center markets in Indiana grew by up to 700 percent, and no markets showed a decline. The state with the next greatest strength is Iowa. The market in the Ames area grew by 700 percent over the period, and the Dubuque area market grew by 200 percent. A couple of Iowa markets showed declines, but none by more than 25 percent. In the Racine and Madison, Wisconsin markets there were increases of over 100 percent, while only one metropolitan area in the state declined during the period. Missouri shows mixed results, but the market in the Columbia area increased by 100 percent, while the largest decline for any area in Missouri was 33 percent. Like Missouri, Illinois (excluding Chicago) shows mixed results, but its strongest growing markets grew less than the strongest markets in any of the surrounding states and of the declining markets, they declined more than any of the markets in the surrounding states. In the Illinois markets where there were declines, they were deeper than markets in any of the surrounding states where there were declines. Also, all of the states surrounding Illinois had markets where there were increases greater than the markets that had increases in Illinois.

In sum, the Midwest state without data center incentives, Illinois, showed significantly weaker growth in data center markets than any of the other states that do have data center incentives. And it is important to consider that these are the results for the period of time when the world-

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[9] We explain this data in detail in sections that follow.
[10] The data center markets in the metropolitan areas of Kentucky are so small that we do not study them here.

wide market for data centers was growing. So, while the data center market in the Chicago area may have been doing well, these data seem to indicate that the data center markets in the rest of the state of Illinois have not been doing nearly as well as the markets in surrounding states that have data center incentives.

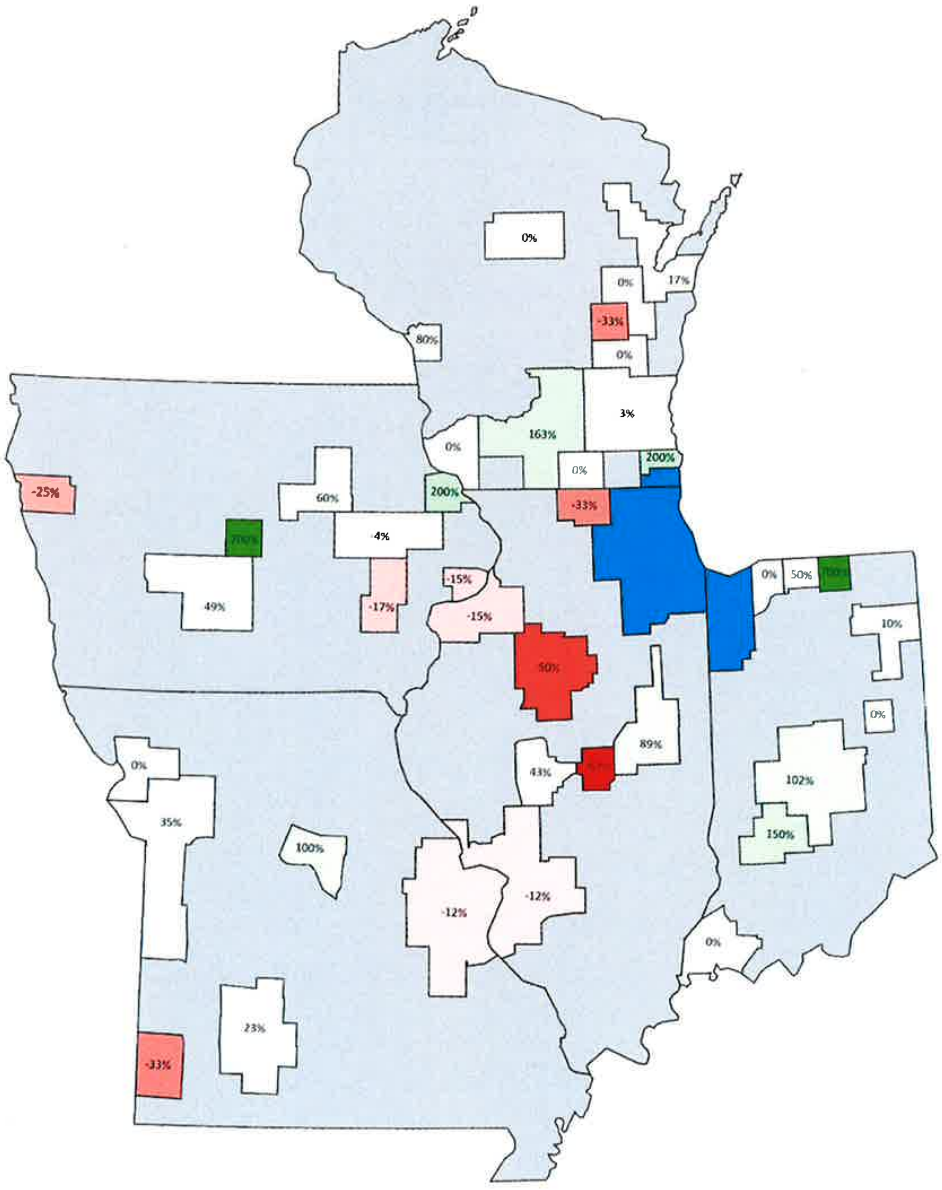
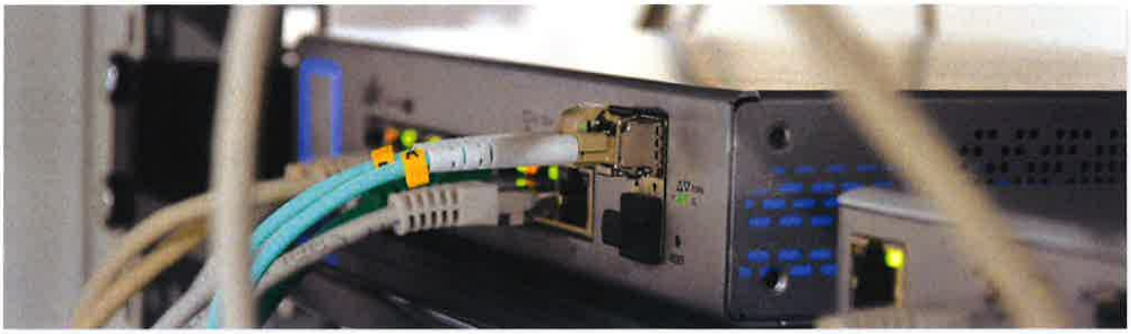


Figure A: Change in Number of Data Processing Establishments from 2004 to 2017 in Select Midwestern Metropolitan Statistical Areas[11] (shading indicates degree of change)

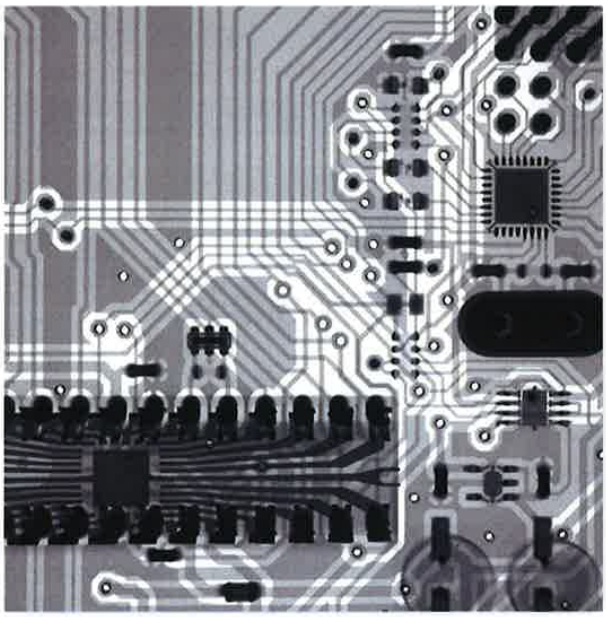
[11] Source: Bureau of Labor Statistics, NAICS 518210. Some metropolitan statistical areas did not have enough establishments during the period for BLS to release statistics. See the appendix for this section for identification of the MSAs.



ILLINOIS AND VIRGINIA

Illinois and Virginia are comparable on many points. Both have a very large metro area in the northern parts of the states (Greater Chicago and Northern Virginia/Washington, D.C.). Both have smaller state capitals. Both have some other urban areas. Both have very rural areas. Both have a core reason for data centers to be attracted to the very large metro area. Chicago and Ashburn, Virginia were both on the list of the 5 original major internet hubs. Chicago has the commodity and options trading financial markets and Ashburn has the legacy tech industry headquarters. In 2012, Northern Virginia had about 50 percent more square feet of data centers than the Greater Chicago Area. By 2016, Northern Virginia had almost 100 percent more square feet than the Greater Chicago Area. In 2012, Virginia updated its data center incentive. Illinois still does not have a specific data center incentive. From 2012 to 2016, Northern Virginia grew about 40 percent, while over the same period the Greater Chicago Area grew by about 20 percent.[12]

The contrast between the two states deepens when considering activity outside of the Greater Chicago Area and Northern Virginia. Soon after the Virginia incentive was enacted, Microsoft announced its data center project in Mecklenburg County. Since then Microsoft has invested $2 billion in the county. QTS has undertaken a large expansion of its data center in Henrico County. Facebook has the potential to invest $3 billion at its data center campus in Henrico County. NxtVn's data center at Virginia Beach could be expanded to $2 billion. Several other data centers are being developed in Virginia Beach. In Illinois, outside of the Greater Chicago Area, there are no data centers of any size or significance contributing to economic development growth.



[12] Source: 451 Research, *Datacenter KnowledgeBase*.

The Data Center Industry's Current Contribution to Illinois

In this section, we provide an analysis of the contribution that the data center industry currently makes to the state of Illinois. Additional information related to this section is provided in the Appendix.

REGIONAL DATA CENTER TRENDS

In this portion of the section we look at data center industry trends in Illinois at a regional level. To define those regions, we employ the ten Economic Development Regions used by the Illinois Department of Employment Security and the Illinois Department of Commerce and Economic Opportunity (DCEO).

The Bureau of Labor Statistics is not allowed to report employment and wages in those instances where public release of those data might enable third parties to identify employment and wages in an individual business. For that reason, of the 10,229 private sector data center industry jobs that the Bureau of Labor Statistics reported statewide in Illinois in 2017, sub-state data are only available for 8,536 of those jobs.

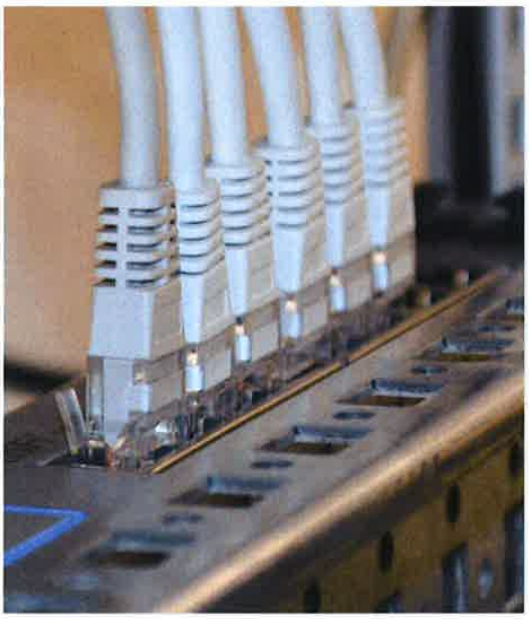


Figure B depicts the sub-state distribution of those 8,536 private sector data center jobs in 2017. As this chart shows, the Bureau of Labor Statistics reported data center employment in only four of Illinois' ten Economic Development Regions that year. The Northeast Economic Development Region (which encompasses the Chicago area) accounted for 93 percent, or by far the largest proportion, of that employment.[13] While the East Central Economic Development Region[14] (which encompasses the Champaign-Urbana area) accounted for five percent, and the Central Economic Development Region[15] (which encompasses the Springfield area) and the North Central Economic Development Region[16] (which encompasses the Bloomington-Peoria area) accounted for one percent each.

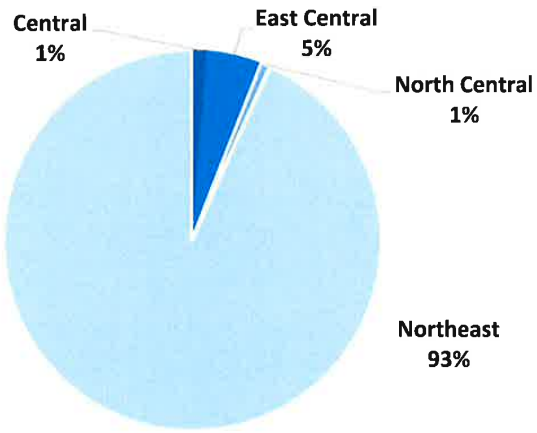


Figure B: Regional Distribution of Private Sector Employment in the Data Center Industry in Illinois in 2017[17]

We can look at trends in regional private sector employment in the data center industry over the ten-year period from 2008 through 2017. Data center employment in the Central Region remained essentially flat over the period, rising from 107 jobs in 2008 to 112 jobs in 2017 (a net gain of five jobs, or 4.7 percent of regional industry employment, over the period). Data center employment in the East Central Region rose from 214 jobs in 2008 to 448 jobs in 2015 and then slipped back to 398 jobs in 2017 (a net gain of 184 jobs, or 86 percent of regional industry employment, over the period). While data center employment in the North Central Region was not reported in four years of the period and came in at 66 jobs in 2017.

In the Northeast Region over the same period, employment slipped from a high of 8,771 jobs in 2007 to a low of 6,577 jobs in 2012, and then rebounded to 7,960 jobs in 2017 (a net loss of 811 jobs, or 9.2 percent of regional industry employment, over the period).

[13] The Northeast Region is comprised of the counties of Cook, DeKalb, DuPage, Grundy, Kane, Kankakee, Kendall, Lake, McHenry, and Will.
[14] The East Central Region is comprised of the counties of Champaign, Douglas, Ford, Iroquois, Piatt, and Vermillion.
[15] The Central Region is comprised of the counties of the counties of Cass, Christian, Greene, Logan, Macon, Macoupin, Menard, Montgomery, Morgan, Sangamon, Scott, and Shelby.
[16] The North Central Region is comprised of the counties of DeWitt, Fulton, Livingston, McLean, Marshall, Mason, Peoria, Stark, Tazewell, and Woodford.
[17] Source: U.S. Bureau of Labor Statistics.

Figure C depicts the number of private sector data center establishments in the Northeast Region from 2008 through 2017. As these data indicate, the number of establishments rose from 430 in 2008 to 516 in 2014, and then slipped 378 in 2017 (a net loss 52, or minus 12.1 percent). It is worth noting that the growth in the number of data center establishments in the region reverses direction and becomes a decline shortly after many states implemented data center incentives in 2012.

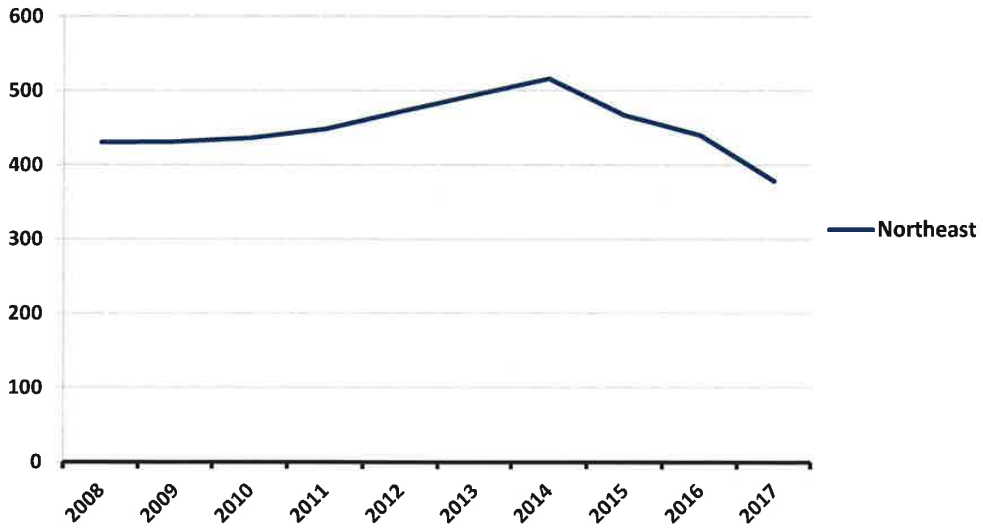


Figure C: Regional Private Sector Data Center Industry Establishments – 2008 to 2017[18]

[18] Source: U.S. Bureau of Labor Statistics.

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Figure D depicts average annual private sector wages in the data center industry in the Northeast Region show the regional change in average annual private sector wages in the data center industry over the ten-year period from 2008 through 2017. As these data indicate, average annual industry wages in the region rose from $96,781 in 2007 to $123,398 in 2017 (a nominal increase of $26,616 or 27.5 percent).

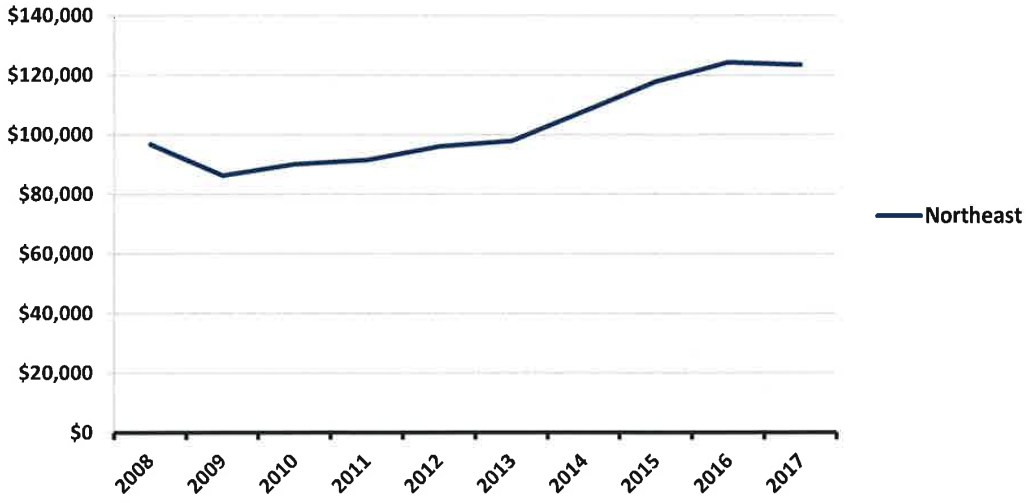

Figure D: Regional Private Sector Employment in the Data Center Industry – 2008 to 2017[19]

[19] Source: U.S. Bureau of Labor Statistics.

DATA CENTER EMPLOYMENT AND WAGE PERFORMANCE

It is important to realize that the data center industry is a high-performance industry in terms of both employment and wage growth. Figure E presents the most recent one-year (2016 to 2017) and five-year (2012 to 2017) statewide growth rates for private sector employment in this industry and compares them to the growth rates for total private employment across all industry sectors in Illinois. As these data show, with respect to one-year growth, statewide employment in Illinois' data center industry increased by 2.9 percent as compared to 0.8 percent across all industries. While in terms of five-year growth, statewide employment in the data center industry increased by 20.6 percent as compared to 7.1 percent across all industries.

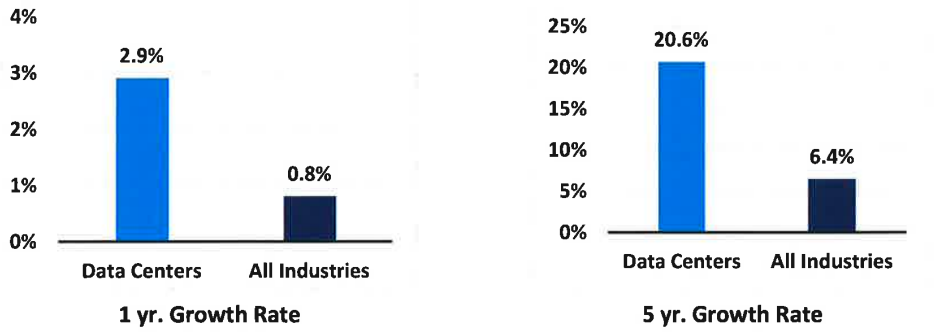

Figure E: Illinois Private Sector Employment Growth in the Data Center Industry vs. All Industries [20]

Figure F provides a similar comparison for one-year and five-year growth rates for private sector wages. With respect to one-year growth, average wages in Illinois' data center industry increased by 0.5 percent as compared to 2.7 percent across all industries. While in terms of five-year growth, average statewide wages in the data center industry increased by 26.1 percent as compared to 11.6 percent across all industries.

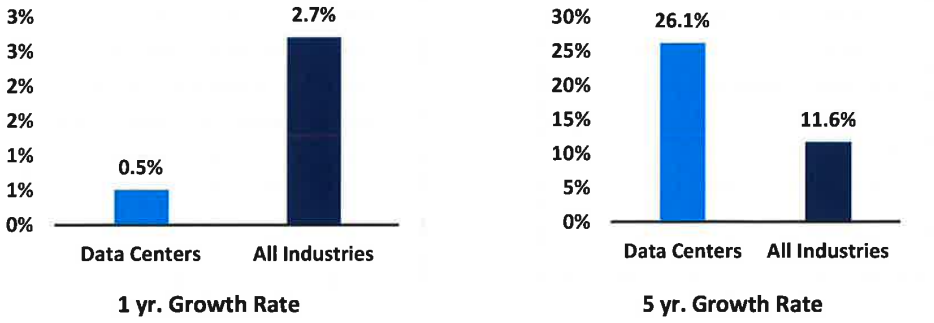

Figure F: Illinois Private Sector Wage Growth in the Data Center Industry vs. All Industries[21]

[20] Source: U.S. Bureau of Labor Statistics.
[21] Source: U.S. Bureau of Labor Statistics.

However, it is equally important to realize that even though Illinois' data center industry is a high-performer relative to other industry sectors in Illinois, it currently under-performs the nationwide trends for the data center industry. Figure G contrasts the most recent one-year (2016 to 2017) and five-year (2012 to 2017) growth rates for private sector data center employment in Illinois to comparable data for the nation as a whole. As these data show, where the most recent one-year employment growth in Illinois' data center industry was 2.9 percent, at the national level the comparable figure was 4.3 percent. Similarly, where the most recent five-year employment growth in Illinois' data center industry was 20.6 percent, at the national level the comparable figure was 23.8 percent.

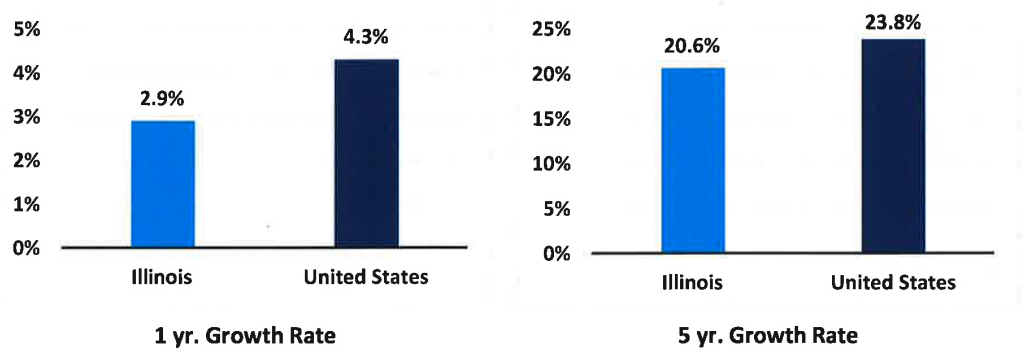

Figure G: Illinois vs. United States Private Sector Employment Growth in the Data Center Industry[22]

Figure H provides a similar contrast between the most recent one-year (2016 to 2017) and five-year (2012 to 2017) growth rates for private sector data center wages. As these data show, where average wages in Illinois' data center industry grew by 0.5 percent in the most recent one-year period, at the national level the comparable figure was 7.1 percent. Similarly, where average wages in Illinois' data center industry grew by 26.1 percent in the most recent five-year period, at the national level the comparable figure was 33.6 percent.

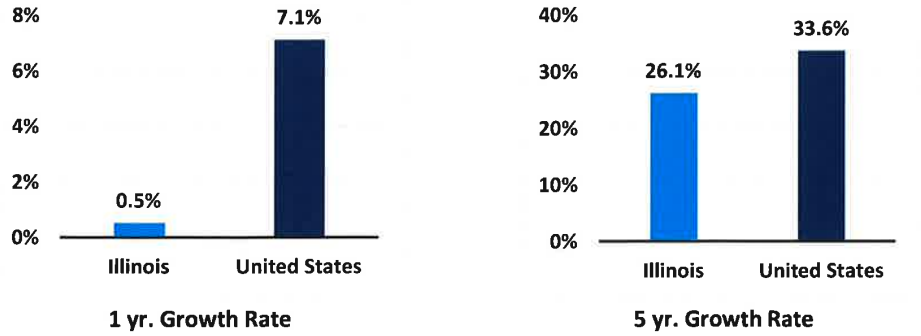

Figure H: Illinois vs. United States Private Sector Wage Growth in the Data Center Industry[23]

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[22] Source: U.S. Bureau of Labor Statistics.
[23] Source: U.S. Bureau of Labor Statistics.

In short, while Illinois' data center industry is a fast-growing sector that pays high wages and is exhibiting growth rates that generally exceed the norm for Illinois' economy, it is still lagging behind the growth rates that this industry is exhibiting nationally.

Economic and Fiscal Impact Contribution

In this portion of the section, we quantify the economic and fiscal contribution that the data center industry makes to the state of Illinois as a whole, and to the four Illinois Economic Development Regions for which the Bureau of Labor Statistics reported data center employment in 2017.[24] Details underlying the estimates reported here are included in the Appendix.

ILLINOIS

In conducting our analysis of the annual economic and fiscal impact that the data center industry had on the state of Illinois as a whole in 2017, we employ the following assumptions:

- Statewide employment in the data center industry was 10,229 in 2017.[25]
- Construction expenditures for new data centers were $121.2 million in 2017.[26]

By feeding these assumptions into the IMPLAN model, we obtain the estimates of annual economic and fiscal impact. As these data indicate, in 2017 the data center industry directly provided approximately:

- 10,229 jobs,
- $1.2 billion in associated wages and salaries, and
- $3.1 billion in statewide economic output to Illinois' economy.

In addition, the data center industry was responsible for generating the following approximate second round indirect and induced economic activity within Illinois:

- 21,269 additional full-time-equivalent jobs (including construction jobs),
- $1.2 billion in additional associated labor income (including construction worker pay), and
- $4.1 billion in additional economic output.

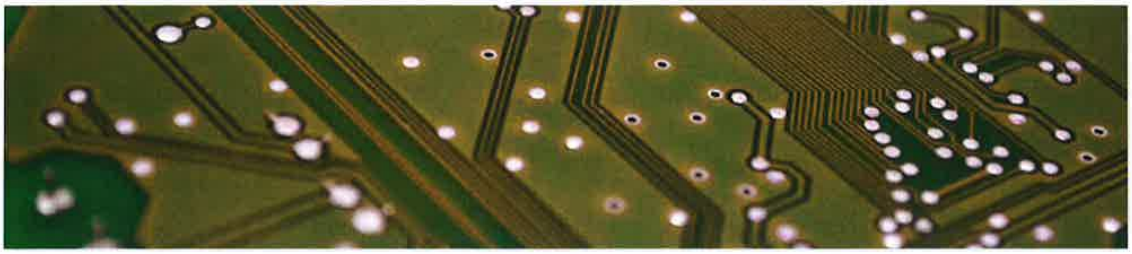
In combination, this means that the data center industry's total 2017 economic impact on Illinois was approximately:

- 31,498 jobs,
- $2.4 billion in labor income, and
- $7.1 billion in economic output.

[24] As in the Data Center Industry Profile in Illinois section, the data used in this section to estimate data center employment are taken from the U.S. Bureau of Labor Statistics and reflect private employment in the Data Processing, Hosting, and Related Services industry. Data Processing, Hosting, and Related Services (NAICS code 518210) is an industry classification within the NAICS code taxonomy that the Bureau of Labor Statistics uses to categorize industry data. It is the most narrowly defined classification within the NAICS code taxonomy that encompasses data centers.

[25] Source: U.S. Bureau of Labor Statistics.

[26] Source: Derived from data center announcements provided by ComEd for the Chicago area only. Assumes 20 percent of announced data center capital investment is comprised of construction expenditures and 80 percent is comprised of equipment purchases. Our analysis is based on construction expenditures only. For ease of explication, all construction expenditures are assumed to take place in a single representative year.



Finally, this economic activity was also responsible for generating a total of approximately $877.5 million in tax revenue in 2017, of which $321.7 million was state and local tax revenue.[27]

CENTRAL ECONOMIC DEVELOPMENT REGION[28]

In conducting our analysis of the annual economic and fiscal impact that the data center industry had on the Central Economic Development Region in 2017, we employ the following assumption: The Central Economic Development Region employment in the data center industry was 112 in 2017.[29] By feeding this assumption into the IMPLAN model, we obtain the estimates of annual economic and fiscal impact.

As these data indicate, in 2017 the data center industry directly provided approximately:

- 112 jobs,
- $5.1 million in associated wages and salaries, and
- $25.6 million in economic output to the Central Economic Development Region's economy.

In addition, the data center industry was responsible for generating the following approximate second round indirect and induced economic activity within the Central Region:

- 120 additional full-time-equivalent jobs (including construction jobs),
- $5.4 million in additional associated labor income (including construction worker pay), and
- $21.6 million in additional economic output.

In combination, this means that the data center industry's total 2017 economic impact on the Central Region was approximately:

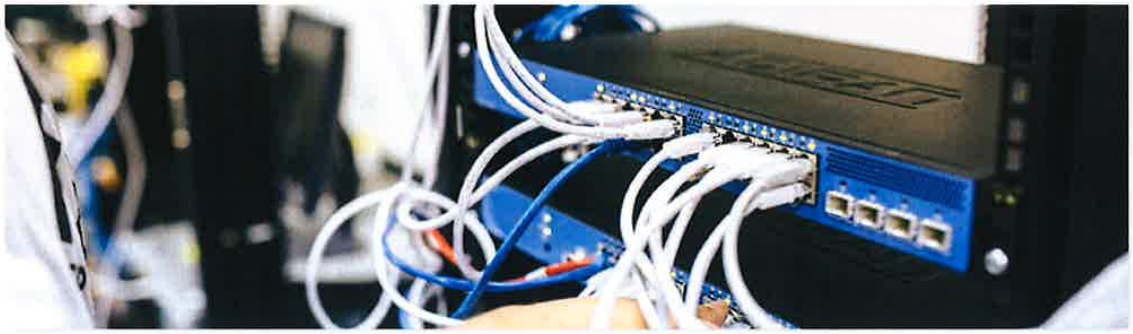
- 232 jobs,
- $10.4 million in labor income, and
- $47.2 million in economic output.

Finally, this economic activity was also responsible for generating a total of approximately $4.5 million in tax revenue in 2017, of which $2.1 million was state and local tax revenue.

[27] It is important to realize that this $321.7 million estimate of state and local taxes paid by the data center industry in 2017 is comprised of all state and local taxes paid by the industry. As such, it would include all government revenue from property taxes, sales taxes, corporate income taxes, electricity excise taxes, license fees, and all other applicable taxes at both the state and the local levels. Data to disaggregate this overall state and local tax estimate is not available.

[28] The Central Region is comprised of the counties of the counties of Cass, Christian, Greene, Logan, Macon, Macoupin, Menard, Montgomery, Morgan, Sangamon, Scott, and Shelby.

[29] Source: U.S. Bureau of Labor Statistics.



EAST CENTRAL ECONOMIC DEVELOPMENT REGION[30]

In conducting our analysis of the annual economic and fiscal impact that the data center industry had on the East Central Economic Development Region in 2017, we employ the following assumption: The East Central Economic Development Region employment in the data center industry was 398 in 2017.[31]

By feeding this assumption into the IMPLAN model, we obtain the estimates of annual economic and fiscal impact. As these data indicate, in 2017 the data center industry directly provided approximately:

- 398 jobs,
- $25.5 million in associated wages and salaries, and
- $98.9 million in economic output to the East Central Economic Development Region's economy.

In addition, the data center industry was responsible for generating the following approximate second round indirect and induced economic activity within the East Central Region:

- 430 additional full-time-equivalent jobs (including construction jobs),
- $20.1 million in additional associated labor income (including construction worker pay), and
- $76.3 million in additional economic output.

In combination, this means that the data center industry's total 2017 economic impact on the East Central Region was approximately:

- 828 jobs,
- $45.5 million in labor income, and
- $175.2 million in economic output.

Finally, this economic activity was also responsible for generating a total of approximately $16.9 million in tax revenue in 2017, of which $6.7 million was state and local tax revenue.

[30] The East Central Region is comprised of the counties of Champaign, Douglas, Ford, Iroquois, Piatt, and Vermillion.
[31] Source: U.S. Bureau of Labor Statistics.

NORTH CENTRAL ECONOMIC DEVELOPMENT REGION[32]

In conducting our analysis of the annual economic and fiscal impact that the data center industry had on the North Central Economic Development Region in 2017, we employ the following assumption: The North Central Economic Development Region employment in the data center industry was 66 in 2017.[33]

By feeding this assumption into the IMPLAN model, we obtain the estimates of annual economic and fiscal impact. As these data indicate, in 2017 the data center industry directly provided approximately:

- 66 jobs,
- $4.2 million in associated wages and salaries, and
- $16.4 million in economic output to the North Central Economic Development Region's economy.

In addition, the data center industry was responsible for generating the following approximate second round indirect and induced economic activity within the North Central Region:

- 86 additional full-time-equivalent jobs (including construction jobs),
- $4.1 million in additional associated labor income (including construction worker pay), and
- $15.2 million in additional economic output.

In combination, this means that the data center industry's total 2017 economic impact on the North Central Economic Development Region was approximately:

- 152 jobs,
- $8.3 million in labor income, and
- $31.6 million in economic output.

Finally, this economic activity was also responsible for generating a total of approximately $3.3 million in tax revenue in 2017, of which $1.4 million was state and local tax revenue.

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[32] The North Central Region is comprised of the counties of DeWitt, Fulton, Livingston, McLean, Marshall, Mason, Peoria, Stark, Tazewell, and Woodford

[33] Source: U.S. Bureau of Labor Statistics.

NORTHEAST ECONOMIC DEVELOPMENT [34]

In conducting our analysis of the annual economic and fiscal impact that the data center industry had on the Northeast Economic Development Region in 2017, we employ the following assumptions:

- Northeast Economic Development Region employment in the data center industry was 7,960 in 2017.[35]
- Construction expenditures for new data centers were $121.2 million in 2017.[36]

By feeding these assumptions into the IMPLAN model, we obtain the estimates of annual economic and fiscal impact. As these data indicate, in 2017 the data center industry directly provided approximately:

- 7,960 jobs,
- $961.1 million in associated wages and salaries, and
- $2.4 billion in economic output to the Northeast Economic Development Region's economy.

In addition, the data center industry was responsible for generating the following approximate second round indirect and induced economic activity within the Northeast Region:

- 16,887 additional full-time-equivalent jobs (including construction jobs),
- $1.0 billion in additional associated labor income (including construction worker pay), and
- $3.2 billion in additional economic output.

In combination, this means that the data center industry's total 2017 economic impact on the Northeast Economic Development Region was approximately:

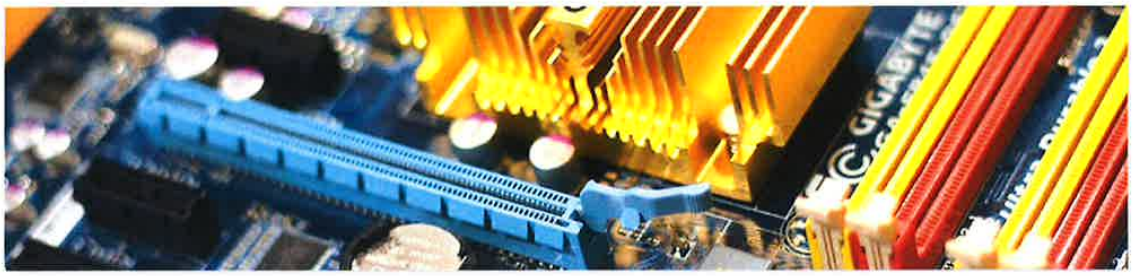
- 24,847 jobs,
- $2.0 billion in labor income, and
- $5.7 billion in economic output.

Finally, this economic activity was also responsible for generating a total of approximately $702.3 million in tax revenue in 2017, of which $246.4 million was state and local tax revenue.

[34] The Northeast Region is comprised of the counties of Cook, DeKalb, DuPage, Grundy, Kane, Kankakee, Kendall, Lake, McHenry, and Will

[35] Source: U.S. Bureau of Labor Statistics.

[36] Derived from data center announcements provided by ComEd for the Chicago area only. Assumes 20 percent of announced data center capital investment is comprised of construction expenditures and 80 percent is comprised of equipment purchases. Our analysis is based on construction expenditures only. For ease of explication, all construction expenditures are assumed to take place in a single representative year.



Other Contributions

In this portion of the section, we focus on some of the potentially less obvious characteristics of the data center industry that also make an important contribution to Illinois' economy. Additional information related to this section is provided in the Appendix.

CAPITAL INVESTMENT AND CONSTRUCTION ACTIVITY

The data center industry is very capital-intensive. According to data from the U.S. Chamber of Commerce, the typical data center of 165,000 ft^2 requires an initial investment of $45 million in building construction and $157 million in servers and other computer equipment.[37] Figure I depicts new investment announcements in the data center industry in the Northeast Economic Development Region for the period from 2012 through the first half of 2018 (recall that the Northeast Region accounts for the bulk of data center employment in the state of Illinois). As these data demonstrate, since 2016 those new investment announcements have averaged at least $657 million per year (includes only partial data for 2018).

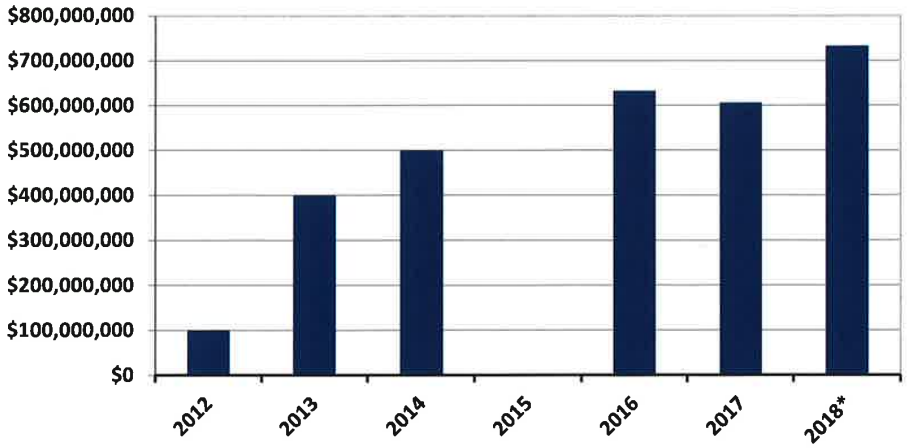


Figure I: Data Center Investment Announcements in the Northeast Economic Development Region – 2012 through 2018 (*includes only partial data for 2018)[38]

[37] U.S. Chamber of Commerce, "Data Centers: Jobs and Opportunities in Communities Nationwide," June 2017. It is worth noting that many data centers are much larger than the 165,000/$45 million building that the U.S. Chamber of Commerce report describes.
[38] Source: ComEd.

In addition to providing capital improvements that add to Illinois' tax base, this capital investment also fuels an on-going demand for data center construction. Moreover, in areas such as the Northeast Region it is often the case that demand leads to the formation of stable and significant industry clusters that support the very specialized construction needs of the data center industry. In addition, in the Northeast Region, most of the data centers were constructed using union labor. This characteristic of the data center industry has particular relevance for Illinois, where employment growth in the state's Construction sector has lagged behind the national norm in recent years.

Once again using the IMPLAN model, Table 1 provides an estimate of the direct impact on the Northeast Economic Development Region's Construction sector from the new data center investments detailed in Figure I.[39] As these data show, the direct employment impact on the Region's Construction sector is estimated to rise from 144 jobs in 2012 to 981 jobs in 2018, while the direct labor income impact is estimated to rise from $9.5 million in 2012 to $64.7 million in 2018, and the direct output impact is estimated to rise from $21.4 million in 2012 to $146.4 million in 2018. In addition, the state and local tax revenue generated by this direct economic activity is estimated to rise from $0.5 million in 2012 to $3.7 million in 2018.

Year	Employment	Labor Income	Output	State and Local Tax Revenue
2012	144	$9,474,724	$21,424,443	$537,614
2013	567	$37,430,487	$84,638,594	$2,123,875
2014	699	$46,164,609	$104,388,371	$2,619,464
2016	864	$57,060,802	$129,027,069	$3,237,734
2017	820	$54,110,709	$122,356,257	$3,070,341
2018*	981	$64,743,793	$146,400,007	$3,673,682

* Includes only partial data for 2018.

Table 1: Direct Economic Impact on the Construction Industry from Data Center Construction in the Northeast Economic Development Region (2018 dollars)

[39] Derived from data center announcements provided by ComEd for the Chicago area only. Assumes 20 percent of announced data center capital investment is comprised of construction expenditures and 80 percent is comprised of equipment purchases. Our analysis is based on construction expenditures only. For ease of explication, all construction expenditures are assumed to take place in a single representative year.

Policy Considerations

Additional information related to this section is provided in the Appendix.

INCENTIVES VARY AMONG STATES

In 2009, only seven states had data center tax incentives. Today, 30 states have incentives that are specifically targeted at attracting data centers. Illinois is surrounded by states that offer data center incentives. Figure J provides a map of the contiguous U.S. in which these states are shaded in blue. The availability of state tax incentives for data centers is often an initial screening criterion used to narrow a locational decision.

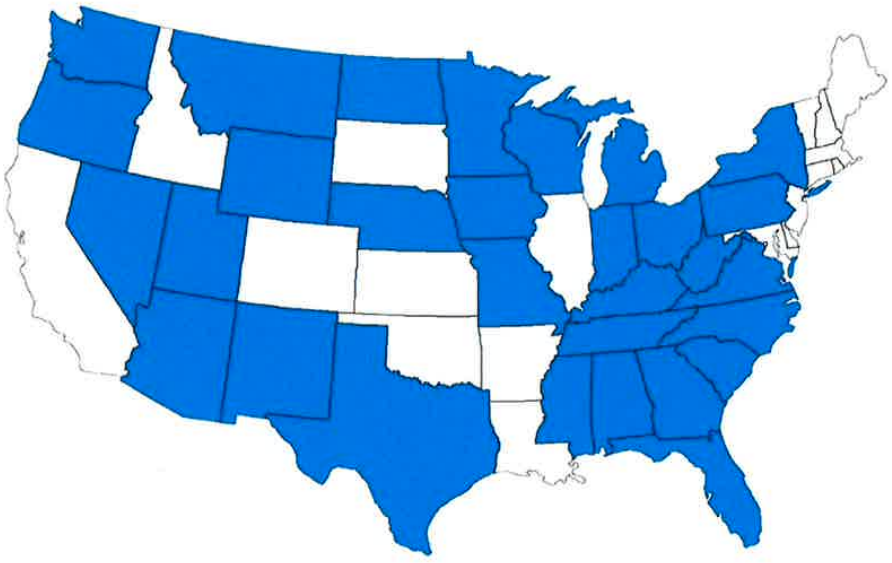
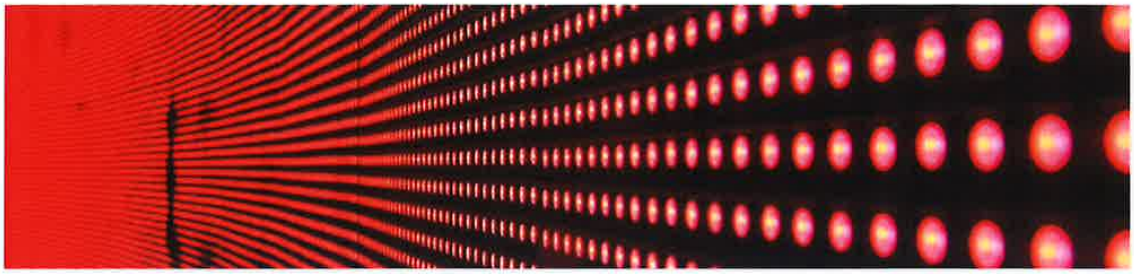


Figure J: States Offering Data Center Incentives in September 2018

In the 25-year history of data center tax incentives, only two states, Louisiana and Washington, have ever terminated data center incentive policies. Louisiana (not a major data center market) had an incentive, enacted in 2012, that allowed for a single sales factor on corporate income



for up to 40 years for approved data centers with more than 50 percent of sales outside of the state. Louisiana stopped approving data centers for the program in 2017.[40] Washington enacted its current data center incentive for rural areas only in 2015. Later we will discuss the difficulties that Washington is experiencing with this version of the state's incentives.

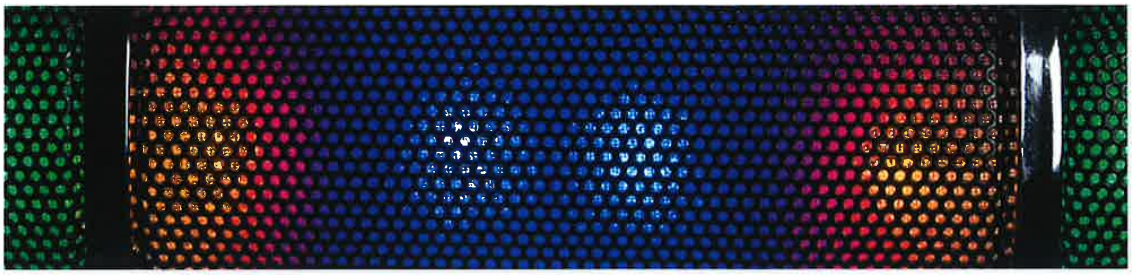
In 2015 and 2016, Virginia, Tennessee, North Carolina, and Utah revised their data center tax incentives. The Virginia incentive was extended without changing the qualifications or expanding the incentives. The revisions in North Carolina, Tennessee, and Utah all made it easier for data centers to qualify for the incentives to more aggressively compete for data center developments. In 2017, Florida and Montana enacted data center tax incentives for the first time. The Florida tax incentive is especially noteworthy as it was enacted while Jacksonville is working to attract data centers to the international undersea cable landing that was recently constructed there. In 2018, Virginia made it easier for property tax purposes for local governments to value the computer equipment in data centers based on their rapid depreciation.

DATA CENTERS FOLLOW INCENTIVES

In 2009, Apple decided to build a $1 billion data center in Maiden, NC instead of Virginia.[41] Both states had vied for the facility.[42] After Apple indicated that it was leaning toward a Virginia location[43], the North Carolina legislature enacted tax incentives to secure the Apple facility.[44] In response to that loss, the Virginia General Assembly voted unanimously to make data center facilities eligible for a sales and use tax exemption on computer equipment. Shortly after that incentive became effective, Microsoft announced its intention to build its Boydton data center campus, the east coast hub for Microsoft's online services, in Mecklenburg County.

Tax incentives have become a critical component of the competition between states for data centers. Moreover, as Microsoft's Boydton campus illustrates, incentives can be particularly helpful in luring data centers to less developed rural communities. In Wyoming, the least populated state in the union, Randy Bruns, director of Cheyenne LEADS, has stated that without the state's data center incentives it would be at a 4 percent to 6 percent tax disadvantage relative to Colorado, Nebraska or Utah.[45] The Wyoming incentive was instrumental in securing a $250 million expansion of Microsoft's Cheyenne data center campus in February of 2015, bringing the company's total investment in the facility to $750 million.

[40] Louisiana State Legislature, Corporate Tax Apportionment Program.
[41] http://www.datacenterknowledge.com/archives/2009/07/06/apple-confirms-maiden-site-for-idatacenter/
[42] http://www.datacenterknowledge.com/archives/2010/02/05/virginia-nc-battling-for-microsoft-data-center/
[43] http://www.datacenterknowledge.com/archives/2009/07/07/how-apple-played-the-incentive-game/
[44] http://www.datacenterknowledge.com/archives/2010/02/05/virginia-nc-battling-for-microsoft-data-center/
[45] http://trib.com/news/local/putting-cheyenne-on-the-data-center-map/article_856c306f-9050-58a6-ad35-5cafb3b32e17.html



South Carolina lawmakers have also attempted to position their state to more aggressively compete in the data center market. After losing a $450 million Facebook data center to North Carolina, South Carolina revised their data center incentive in May 2015 to lower the required amount of investment and to exempt data centers from taxes on electricity as well as sales taxes on equipment. State Representative Phyllis Henderson (R-Greenville) stated,

> *The main piece of this legislation is because of North Carolina. We were just losing projects right and left to them.*[46]

In addition, the competition between Virginia and North Carolina did not end with North Carolina beating out Virginia for the Apple facility in 2009,[47] and Virginia beating out North Carolina for the Microsoft facility in 2010. In September 2015, North Carolina lowered its investment criteria for its data center incentive and provided a tax exemption for data center purchases of electricity to better compete with Virginia, and to better target multi-tenant co-location facilities that typically provide a larger number of total jobs.[48]

A similar scenario played out over a $1.8 billion Facebook data center in 2016. Facebook intended to locate in Utah, but local officials balked at a proposed package of local incentives. After Facebook announced that it would build the facility in New Mexico, where state-wide incentives were already in place, Utah state legislators voted to enact statewide data center incentives.[49] Early in 2018, the first project to take advantage of those Utah incentives was announced – a 1 million square foot Facebook data center in Eagle Mountain.[50] The first phase alone of the project will generate $837,000 in property taxes on land that currently generates only $66 in property tax revenue.[51]

In 2013, Arizona provided owners and users of data centers with a sales abatement on qualifying equipment purchases. Since the law was enacted, there has been significant increased data center investment in the Phoenix market. Some notable examples are Apple's $2 billion data center hub,[52] CyrusOne's 100MW data center campus,[53] and the 277-acre Microsoft development for a data center to support its Azure Cloud platform.[54]

[46] http://www.thestate.com/news/politics-government/article14403305.html
[47] http://www.datacenterknowledge.com/archives/2009/06/03/its-official-apple-to-north-carolina
[48] http://www.datacenterknowledge.com/archives/2015/10/01/north-carolina-makes-data-center-tax-breaks-easier-to-get
[49] https://www.theguardian.com/technology/2016/sep/14/facebook-data-center-new-mexico-utah
[50] https://www.sltrib.com/news/politics/2018/06/05/facebooks-data-center-deal-with-eagle-mountain-includes-a-5-million-sweetener-from-the-state/
[51] https://www.sltrib.com/news/politics/2018/05/30/facebook-to-bring-data-center-to-eagle-mountain/
[52] https://www.bizjournals.com/phoenix/news/2018/08/15/see-inside-apples-2-billion-data-center-in-mesa.html
[53] https://www.datacenterknowledge.com/archives/2015/06/29/cyrusone-kicks-off-third-massive-phoenix-data-center
[54] https://www.forbes.com/sites/ellenbarber/2018/09/10/microsoft-just-bought-277-acres-in-arizona/#6c1b94156002

The state of Michigan enacted data center incentives 2015. Those incentives enabled Michigan to beat out New York in a competition for a new $5 billion Switch data center in Grand Rapids. The Switch facility is expected to provide 1,000 jobs and will be the largest data center in the eastern half of the U.S.[55] After Pennsylvania enacted data center tax incentives in 2016, the colocation provider Iron Mountain announced plans to upgrade and expand its underground data center campus.[56]

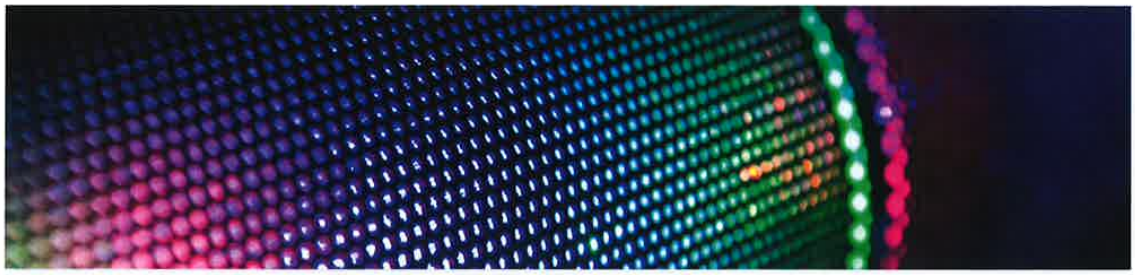
Most recently, days after the governor of Georgia signed a bill in May 2018 to extend its data center tax incentive to colocation data centers, the colocation provider Switch announced plans to begin construction on a 1 million square foot data center campus in Atlanta.[57] Georgians are hoping that with this new version of their incentive the Atlanta area can overtake the New York Tri-state Area in terms of data center capacity.[58]

The Washington Experience with Data Center Incentives

Washington state's experience with data center incentives is also illustrative, but in a different way. Washington is home to Microsoft's corporate headquarters in Redmond. In December 2007, Washington's Attorney General ruled the state's data center incentives invalid. Microsoft and Yahoo immediately halted construction on data center facilities in rural Quincy, Washington, and Microsoft subsequently chose to move its Windows Azure cloud computing service to another state.[59] Facebook and Amazon also cited state and local taxes as an important consideration in their decisions to construct new data center facilities in neighboring Oregon.[60]

Washington's data center incentives were legislatively re-enacted in April 2010, sparking a construction boom and up to $2 billion in new private investment in the state.[61] But, in June 2011 the incentives were allowed to lapse, which once again halted data center growth in Washington and drove a $1 billion investment boom in nearby Oregon as Adobe, Apple,[62] Fortune Data Centers,[63] and NetApp[64] all announced that they would be building data centers there rather than in Washington. In May 2012, Washington again re-enacted their data center incentives,[65] only to fail to reauthorize them during the 2014 legislative session.[66] Microsoft subsequently cited that lack of reauthorization as a motivating factor in its decision to build a new $1.1 billion data center in West Des Moines, Iowa rather than Washington.[67] Washington then re-enacted a data center incentive yet again in July 2015.[68]

[55] http://www.freep.com/story/money/business/michigan/2015/11/16/data-center-switch-steelcase-grand-rapids-pyramid/75896236/
[56] http://www.ironmountain.com/about-us/news-events/news-categories/press-releases/2016/october/iron-mountain-upgrades-expands-western-pennsylvania-data-center-campus
[57] https://www.switch.com/georgia-governor-nathan-deal-signs-switch-bill-data-center-tax-exemption-legislation/
[58] http://www.developdouglas.com/news/new-tax-incentive-expected-generate-jolt-data-center-investment-georgia
[59] http://www.datacenterknowledge.com/archives/2010/02/01/group-pushes-for-change-in-washington-state
[60] http://www.greenbiz.com/news/2010/05/05/states-use-tax-incentives-lure-data-centers/
[61] https://washingtonstatewire.com/data-center-fumble-costs-jobs-in-washington-state-and-maybe-big-money/
[62] http://www.datacenterknowledge.com/archives/2012/02/21/apple-confirms-plans-for-oregon-data-center
[63] http://www.datacenterknowledge.com/archives/2011/10/21/fortune-expands-to-portland-oregon
[64] http://www.datacenterknowledge.com/archives/2011/10/17/digital-realty-to-build-netapp-facility-in-oregon
[65] https://washingtonstatewire.com/data-center-fumble-costs-jobs-in-washington-state-and-maybe-big-money/
[66] http://blogs.seattletimes.com/opinionnw/2014/04/28/new-microsoft-data-center-in-iowa-offers-a-billion-dollar-lesson/
[67] http://blogs.seattletimes.com/opinionnw/2014/04/28/new-microsoft-data-center-in-iowa-offers-a-billion-dollar-lesson/
[68] https://wiredre.com/data-center-tax-incentives-extended-in-washington-state/



Presently, Washington State is considering revising its current data center incentive. The 2015 incentive is only available for facilities in rural counties. As the Washington State Department of Commerce has documented, the effect of the incentive has been to drive many colocation data centers a few miles over the border with Oregon to the town of Hillsboro.[69] Colocation data centers are best suited to more urban, rather than rural, locations. This experience provides a warning to states attempting to design narrowly-targeted incentives. Because the majority of states now offer data center incentives and many locations around the country are good substitutes for each other, businesses can pick and choose the most advantageous location for the type of facility that they are constructing.

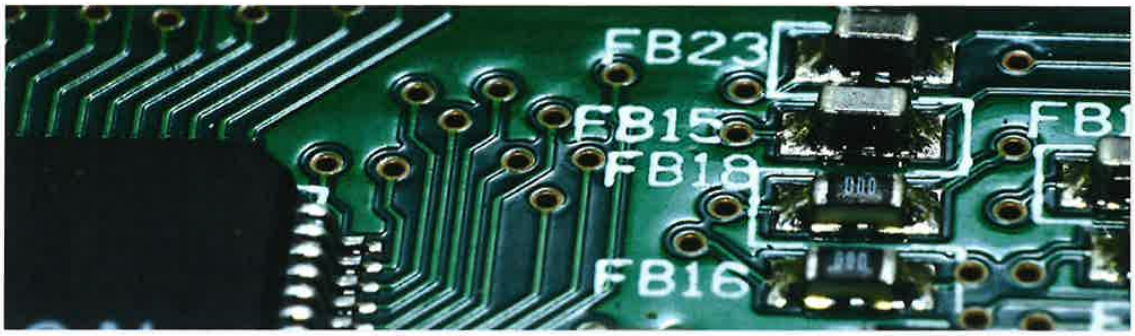
GAINS AND LOSSES

There are some obvious lessons to be learned from the experiences of Wyoming, Nebraska, Colorado, Utah, South Carolina, Virginia, North Carolina, Michigan, New York, New Mexico, Washington, Oregon, Illinois, and Iowa.

First, as the experience of Chicago and Illinois illustrate, some colocation data centers will be located in every major metropolitan area in order to serve the needs of businesses that must have data located nearby. However, without incentives, the only data centers that will be built in areas without incentives are those that cannot serve the needs of clients if they are built in other areas with incentives. In general, giant, rural data centers will only be located in places offering tax incentives because those facilities are very sensitive to cost and not very sensitive to proximity to business locations or large populations of users.

Secondly, no state has a natural lock on attracting data centers. Only a few years ago, New York was the world's largest market for data centers. In 2015, Virginia took over that spot because the state and localities within it worked aggressively to attract data centers. The state of Washington would seem to be the obvious, natural choice for Microsoft's data centers because the company is headquartered in Washington. However, when Washington legislators decided that they didn't need data center incentives to attract data centers to the state, Microsoft and other firms located their data centers in other states that provided lower total costs of operating. And the current incentive in the State of Washington has created a colocation data center boom in Hillsboro, Oregon (near the border with Washington) where data centers can serve clients in both Oregon and Washington while taking advantage of the lower tax environment in Oregon.

[69] Washington State Department of Commerce, State of the Data Center Industry: An Analysis of Washington's Competitiveness In This Fast-Growing High-Tech Field, January 2018.



Finally, debates over tax incentives are often characterized in terms of "gains" and "losses." Such terminology confuses the purpose of legislation with a zero-sum game. As with any legislation, the best terminology for evaluation is whether the enacted incentives are effective policies at serving the public interest. In the case of data centers, are states better off with more data centers located within their borders than would locate there without the incentives? Thirty states offer incentives to attract data centers to locate within their borders. There will always be some data centers that must be located in one place or another because of the customers that they serve. But there are many data centers that can perform their duties just as effectively in several locations. The data centers in that latter category will take advantage of incentives that a state offers. Large enterprise data centers that can locate in rural areas often fall into that category. People often recognize that the large data centers located in Iowa, southern Virginia, and rural North Carolina and Washington are there because the costs – including taxes – of those locations were so attractive. In those cases, it is easy to see the effectiveness of the incentive policies at attracting data centers to a state. However, incentives, or lack thereof, also have important effects in urban areas that will always have some amount of data center activity. This is clearly seen in the ability of data centers that need an urban environment to find one with incentives in Oregon when one without incentives is not available in Washington.

Business Climate And Taxes

According to Forbes, "Illinois is home to [the headquarters of] 68 of the 1,000 biggest companies in the U.S. by revenue—fourth most among states. They include Boeing, Abbott Labs, Caterpillar and Kraft Foods. However, the net migration rate out of Illinois over the last five years is the worst in the U.S."[70] Why do these companies leave the state? CNBC's America's Top States for Business 2018 and Forbes' Best State for Business 2018 rankings shed some light on Illinois' weaknesses. Both rank Illinois in the bottom half of all states in the U.S, with an overall rank of 28 by CNBC and a rank of #37 by Forbes. According to CNBC, Illinois fares especially poorly, with a grade of F (rank 47), in the "Business Friendliness" category, which is linked to the state's "onerous regulations", which are also criticized by Forbes (rank 40 for regulatory environment).[71]

[70] Forbes 2018 Best State for Business, Illinois Profile.
[71] CNBC: America's Top States for Business 2018 - A scorecard on state economic climate.

Table 2 shows competitor states Indiana, Wisconsin, Iowa and Missouri outranking Illinois not only in the overall rankings but especially in the subcategories "Cost of Doing Business / Business Costs" and "Business Friendliness / Regulatory Environment", in which Indiana scores especially well with ranks in the top five for three of the four subcategories.

	Indiana	Wisconsin	Iowa	Missouri	Illinois	Illinois Grade
Overall	16	17	18	23	28	-
Workforce	40	22	39	41	25	B-
Infrastructure	2	23	24	11	22	C+
Cost of Doing Business	5	21	6	8	29	C+
Economy	20	19	34	25	42	D+
Quality of Life	46	24	7	45	30	D+
Technology & Innovation	28	20	26	22	12	B+
Education	35	14	13	18	17	B
Business Friendliness	4	24	15	27	47	F
Access to Capital	24	25	36	22	4	A
Cost of Living	10	24	12	6	25	C

Table 2: CNBC: America's Top States for Business 2018 - A scorecard on state economic climate[72]

The State of Illinois' greatest strengths are in the "Access to Capital" and "Technology & Innovation" categories, in which they outrank the above-mentioned competitors.

A separate ranking prepared by Chief Executive Magazine, the "2018 Best & Worst States for Business", ranks Illinois 48th overall and 46th for its "Taxes and Regulations".[73] Similarly, the

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[72] CNBC: America's Top States for Business 2018 - A scorecard on state economic climate.
[73] Chief Executive Magazine 2018 Best & Worst States for Business.
[74] Tax Foundation, 2018 State Business Tax Climate Index.

Tax Foundation's "2018 State Business Tax Climate Index" places Illinois 29th, which is a lower rank than in 2017 because of recent tax increases in the state, including an increase of "the state's corporate income tax rate from 7.75 to 9.5 percent."[74] Indiana and Missouri's business taxes are considered more favorable, ranking them 9th and 16th respectively, while Wisconsin and Iowa rank 38th and 40th overall (see Table 3).

State	Business Tax Climate Index Ranking	Corporate Tax Rank	Individual Income Tax Rank	Sales Tax Rank	Property Tax Rank	Unemployment Insurance Tax Rank
Indiana	9	23	10	9	4	10
Missouri	16	5	28	24	7	7
Illinois	29	36	16	35	45	42
Wisconsin	38	29	43	7	26	40
Iowa	40	48	33	19	39	34

Table 3: Tax Foundation. 2018 State Business Tax Climate Index.[75]

Given the importance of taxes to businesses as they make location decisions, we will briefly discuss the corporate income tax, sales tax, property tax and unemployment insurance tax in Illinois and compare it to its competitor states.

CORPORATE INCOME TAX

The Illinois corporate income tax rate imposed on corporations is 9.5 percent, consisting of a corporate income tax rate of 7 percent and a Personal Property Replacement Tax (PPRT) of 2.5 percent, ranking it 36th of all states by the Tax Foundation in 2018. Indiana's 5.75 percent rate is the lowest rate of the five states (see Table 4) compared and currently ranks Indiana 23rd, which is certain to improve as its rate is scheduled to decrease to 4.9 percent by 2022. Iowa's system of four tax brackets with rates ranging from 6-12 percent translates into a low ranking of 48th. Missouri and Wisconsin also have lower corporate income tax rates than Illinois.

	Illinois	Indiana	Iowa	Missouri	Wisconsin
State Corporate Income Tax	9.5%[77]	5.75%[78]	6.0-12.0%[79]	6.25%	7.90%

Table 4: Corporate Income Tax Rates (2018)[76]

[75] Tax Foundation, 2018 State Business Tax Climate Index.
[76] Federation of Tax Administrators, Corporate Income Tax Rates 2018.
[77] The Illinois rate of 9.5% is the sum of a corporate income tax rate of 7.0% plus a personal property replacement tax of 2.5%, which is passed through to local governments.
[78] The Indiana Corporate tax rate was reduced to 5.75% on 7/1/18, and Indiana's rate is scheduled to decrease to 4.9% by 2022.
[79] Iowa's four tax brackets range from $25,000-$250,001.

SALES TAX

The Illinois state sales tax rate of 6.25 percent is not the highest of the comparison states, as Indiana's rate is 7 percent, but Indiana does not impose a local sales tax, which can range from 0.25-4.75 percent in Illinois, increasing the total sales tax levy in Illinois to 10 to 11 percent in some localities. Missouri has a comparably wide range of local sales tax rates due to a large number of taxing entities. Iowa's local option sales tax doesn't vary as much, but it has about the same number of different municipal taxing entities (1,275) as Illinois (1,229) and Missouri (1,034).[80] Illinois' higher rates and large number of taxing entities translates into a rank of 35 by the Tax Foundation. Indiana's and Wisconsin's more favorable sales tax structure places them into higher ranks (#9 and #7 respectively).

State	State Sales Tax Rate	Local Sales Tax Rate Range	Number of Municipal Tax Rates/Entities[82]
Illinois	6.25%	0.25%-4.75%	1,229
Indiana	7.0%	n/a	-
Iowa	6.0%	1.0%	1,275
Missouri	4.225%	0.5%-5.388%	1,034
Wisconsin	5.0%	0.1%-0.6%	65

Table 5: Sales Tax Rates[81]

PROPERTY TAX

Property taxes are the reason for Illinois' overall lowest rank – 46 – of the Tax Foundation's subcategory rankings. In Illinois, property taxes are only levied at the local level, not the state. But, in 2016, the state had more than 6,000 separate taxing districts (including counties, townships, road districts, cities, villages, incorporated towns, and school districts), which is a driving factor in the state's overall high property tax rates. Consequently, the average property tax collection per capita of $2,007 in Illinois is not surprising and significantly above the average in Missouri ($960/rank 7) and Indiana ($970/rank 4).

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[80] Tax Policy Center. Urban Institute & Brookings Institution. Local Sales Tax Rates. Rates as of April 1, 2018.
[81] Tax Policy Center. Urban Institute & Brookings Institution. Local Sales Tax Rates. Rates as of April 1, 2018.
[82] Includes each town, city, and county that the state lists as having a general sales tax rate, even if multiple jurisdictions use the same percentage. Does not include special jurisdictions.

UNEMPLOYMENT INSURANCE TAX RATES AND WORKERS' COMPENSATION INSURANCE

Illinois received a low rank of #42 for unemployment insurance tax rates by the Tax Foundation. This is especially apparent when compared to Indiana (#10) and Missouri (#7).[83] Illinois' ranking is negatively impacted by several factors: first, its minimum tax rate of 0.55 percent compared to 0 percent (none) in other states, including Iowa, Missouri and Wisconsin; second, its maximum rate of 7.35 percent, which is below all four competitor states but above the 5.4 percent rate seen in several other states in the U.S. (i.e. FL and OR); third, its taxable wage base of $12,960 – which is below that in Iowa ($29,300) and comparable to Missouri and Wisconsin, but higher than in Indiana ($9,500) and above the federal taxable wage base of $7,000. Fourth, Illinois' experience formula is based on a benefits ratio, which is "based solely on the business's experience and [is] therefore nonneutral by design"[84] in comparison to states (including IN, MO, and WI) relying on state experience. In addition, a company in Illinois can only qualify for the experience rating after three years, which is the case in fourteen other states but above the one to two-year period in 32 other states.

State	Rank	Min. Rate	Max. Rate	Taxable Wage Base
Illinois	42	0.55%	7.35%	$12,960
Indiana	10	0.5%	7.4%	$9,500
Iowa	34	0.0%	8.0%	$29,300
Missouri	7	0.0%	9.75%	$13,000
Wisconsin	40	0.0%	12.0%	$14,000

Table 6: Unemployment Insurance Tax Rates[85]

Illinois' Workers Compensation Employer Insurance costs per $100 of payroll ($1.25 per $100 of payroll) are about the U.S. average rate, ranking the state 25th lowest and just above Missouri ($1.15 per $100 of payroll). Indiana stands out with a low rate of $0.85 (Rank 6) and Iowa and Wisconsin have the highest rates and thus lowest rankings (#38 and #46 respectively).

State	Workers' Compensation Employer Insurance Costs Per $100 of Payroll (2015)	Rank*
Illinois	$1.23	25
Indiana	$0.85	6
Iowa	$1.57	38
Missouri	$1.15	23
Wisconsin	$1.74	46

*Ranking from lowest to highest rate

Table 7: Workers' Compensation Insurance Rates[86]

[83] According to the Tax Foundation, states with higher ranks "have rate structures with lower minimum and maximum rates and la wage base at the federal level. In addition, they have simpler experience formulas and charging methods, and they have not complicated their systems with benefit add-ons and surtaxes."
[84] Tax Foundation, 2018 State Business Tax Climate Index.
[85] Tax Foundation, 2018 State Business Tax Climate Index.
[86] National Academy of Social Insurance, Workers' Compensation Benefits, Coverage, and Costs – 2015 Data.

Illustrations of the Development Potential of Data Centers

In this section we illustrate the economic and fiscal impact potential if just one new large data center were to locate in Illinois. We describe one large data center that was recently announced for construction in Iowa. We then illustrate the impact of constructing and operating a data center like that in three counties in Illinois, Bond, Kane, and McLean. We use the IMPLAN model to estimate the impacts, and, for ease of explication, we assume that all construction expenditures take place in the first year. The impact of constructing and operating the same facility in different counties varies because different counties are home to different industries that will feed off of the new development. The more populated and more economically diverse a local economy is, the more of the economic impact the county can absorb. When new development occurs in a less populated and less economically diverse county, then more of the economic development impact spills over into the surrounding counties. Details underlying the estimates reported here are included in the Appendix.

THE ILLUSTRATIVE DATA CENTER PROJECT

In the summer of 2017 Apple announced that it would build a 400,000 square foot data center on a 2,000-acre parcel of land in Waukee, Iowa.[87] The cost of construction was announced at $1.375 billion, with 550 people being involved in the construction and beginning operation of the facility. On an ongoing basis, Apple committed to employ 50 full-time workers. In the scenarios that follow, we consider the impact on some select localities and the State of Illinois if a data center like that were to be constructed in rural and suburban locations in Illinois. In each scenario we employ the following assumption: the potential new data center will cost $1.375 billion to build in 2018 and employ 50 full-time workers on an ongoing basis.[88]

THE ECONOMIC AND FISCAL IMPACT IN BOND COUNTY

Bond County is a distant suburb of St. Louis. Connectivity, accessibility, and power would be sufficient to support a large data center in the county. A significant number of workers would come from other area counties. In 2018, such a data center would potentially provide approximately:

[87] Des Moines Register, "7 Things to Know About the Apple Data Center in Waukee," August 25, 2017.
[88] This would not be an unusually large enterprise data center for the large IT companies.

- 2,530 construction jobs and 50 operational jobs,
- $116.5 million in associated construction wages plus $2.3 million in associated operational wages and salaries, and
- $274.8 million in economic output from construction and $11.5 million in economic output from operations to the Bond County economy.

After accounting for all of the additional indirect effects that the new data center would induce as the new investment ripples through the local economy, a new large data center constructed in 2018 would have a potential total economic impact on the Bond County economy of approximately:

- 3,270 jobs,
- $138.7 million in labor income, and
- $368.8 million in economic output.

Finally, this economic activity in Bond County would also be responsible for generating a total of approximately $38.9 million in tax revenue in 2018, of which $13.4 million would be state and local tax revenue.

THE ECONOMIC AND FISCAL IMPACT IN KANE COUNTY

Kane County is a distant suburb of Chicago. Connectivity, accessibility, power, and workforce would be sufficient to support a large data center in the county. In 2018, such a data center would potentially provide approximately:

- 1,798 construction jobs and 50 operational jobs,
- $120 million in associated construction wages plus $3.5 million in associated operational wages and salaries, and
- $274.9 million in economic output from construction and $12.7 million in economic output from operations to the Kane County economy.

After accounting for all of the additional indirect effects that the new data center would induce as the new investment ripples through the local economy, a new large data center constructed in 2018 would have a potential total economic impact on the Kane County economy of approximately:

- 2,744 jobs,
- $165.6 million in labor income, and
- $420.2 million in economic output.

Finally, this economic activity in Kane County would also be responsible for generating a total of approximately $53.8 million in tax revenue in 2018, of which $15.7 million would be state and local tax revenue.

THE ECONOMIC AND FISCAL IMPACT IN MCLEAN COUNTY

McLean County is a largely rural county; however, the population of the Bloomington-Normal twin cities exceeds 100,000. Three interstate highways intersect in the county, and a significant amount of fiber already exists in the county. Connectivity, accessibility, power, and workforce would be sufficient to support a large data center in the county. In 2018, such a data center would potentially provide approximately:

- 2,088 construction jobs and 50 operational jobs,
- $118.4 million in associated construction wages plus $3.5 million in associated operational wages and salaries, and
- $273.8 million in economic output from construction and $12.7 million in economic output from operations to the McLean County economy.

After accounting for all of the additional indirect effects that the new data center would induce as the new investment ripples through the local economy, a new large data center constructed in 2018 would have a potential total economic impact on the McLean County economy of approximately:

- 3,132 jobs,
- $165.2 million in labor income, and
- $417.5 million in economic output.

Finally, this economic activity in McLean County would also be responsible for generating a total of approximately $49.3 million in tax revenue in 2018, of which $15 million would be state and local tax revenue.

THE STATEWIDE ECONOMIC AND FISCAL IMPACT IN ILLINOIS

The potential county impacts described above of a potential large new data center locating in Illinois represent only the portion of the total impact on the economy that would occur in that county. However, in reality, such a facility would have effects beyond the boundaries of the county where the data center would be located. Here we report the statewide impact of attracting a large new data center to Illinois. These estimates include the impact on the local county, so that the estimates for the state of Illinois should not be added to the county estimates previously reported.

By feeding the construction size assumption into the IMPLAN model, we obtain the estimates of annual economic and fiscal impact.[89] A new large data center constructed in 2018 would have a potential total economic impact on the Illinois economy of approximately:

- 3,360 jobs,
- $203.9 million in labor income, and
- $521.7 million in economic output.

Finally, this economic activity would also be responsible for generating a total of approximately $66.7 million in tax revenue in 2018, of which $20.2 million would be state and local tax revenue.

[89] For ease of explication, all construction expenditures are assumed to take place in a single year.

Potential Impact of Indiana's New Development on the Chicago Area

In the previous sections, we discussed the special nature of the city of Chicago and the Chicago area for the data center market in Illinois. Recent developments in northwest Indiana make it important to consider the degree to which the Illinois data center market in the Chicago area may soon change.

Recently, workers broke ground on a $40 million data center in Hammond, Indiana.[90] The site totals 77 acres allowing for expansion of the project to a total of $200 million of data center. According to the Chicago Tribune, the site was selected for the data center project for a number of reasons: The large data center market in the city of Chicago is just yards away, the lake-front property provides for easy cooling of the computer equipment, the site already has fiber connectivity to Chicago, the project benefitted from tax incentives, and the property is in more "tax-friendly" Indiana.[91] So the Indiana data center will benefit from the connection to Chicago, while taking advantage of the tax environment in Indiana. However, it could be a harbinger of more data center development on underdeveloped property in Hammond and Gary, Indiana. Data centers there could provide businesses with many of the advantages of the Chicago data center market at a somewhat lower cost if only because of the lower taxes in Indiana. Just as we saw the sizable increase in economic development impact of a single large data center locating in a distant Chicago suburb, there could also be sizable decreases in economic activity in Chicago if new data centers locate just over the border with Indiana.

This possibility should not be discounted, because it is almost exactly what has happened in Washington and Oregon. Washington's data center incentive which is only available in rural counties, has created an environment where data centers are located in urban areas just across the border in Oregon.[92]

[90] Tanwen Dawn-Hiscox, "Developers Break Ground on Chicago State Line Data Center," DatacenterDynamics, August 16, 2018.
[91] Karen Caffarini, "Data Center Hopes to Rise from Ashes of Defunct Hammond Power Plant," Chicago Tribune, June 25, 2018.
[92] Washington State Department of Commerce, State of the Data Center Industry: An Analysis of Washington's Competitiveness In This Fast-Growing High-Tech Field, January 2018.

Conclusion

The need for data centers is increasing at a much higher rate than the increase in the capacity of data storage devices. For the foreseeable future, the world will need an increasing number of data centers to maintain data in secure and accessible environments. Currently, Chicago is the third largest data center market in the United States. However, it is growing much more slowly than other major markets. From June 2017 to June 2018, the Chicago data center market grew at a rate of 7 percent. At the same time, the Atlanta market grew 12 percent, the Northern Virginia market grew 16 percent, and the Phoenix market grew 26 percent. And for all of the success of the Chicago area at attracting data centers, the rest of the state of Illinois has very few data centers. This is typical of states that have places with special catalysts for data center location, but that do not have state-wide data center incentives.

In comparison to its neighboring states, Illinois, the state without data center incentives, showed significantly weaker growth in data center markets than any of the other states that do have data center incentives. And it is important to consider that these are the results for the period of time when the world-wide market for data centers was growing. So, while the data center market in the Chicago area may have been doing well, these data indicate that the data center markets in the rest of the state of Illinois have not been doing nearly as well as the markets in surrounding states that have data center incentives.

The Northeast Economic Development Region, which encompasses the Chicago area, accounted for 93 percent, or by far the largest proportion, of employment in the data center industry. In terms of five-year growth, statewide employment in the data center industry increased by 20.6 percent as compared to 7.1 percent across all industries. However, it is important to realize that even though Illinois' data center industry is a high-performer in terms of job growth relative to other industry sectors in Illinois, it currently under-performs the nationwide trends for the data center industry. Similarly, where average wages in Illinois' data center industry grew by 26.1 percent in the most recent five-year period, at the national level the comparable figure was 33.6 percent.

In 2017 the data center industry's total 2017 economic impact on Illinois was approximately 31,500 jobs, $2.4 billion in labor income, and $7.1 billion in economic output. This economic activity was also responsible for generating a total of approximately $877.5 million in tax revenue in 2017, of which $321.7 million was state and local tax revenue.[93]

[93] It is important to realize that this $321.7 million estimate of state and local taxes paid by the data center industry in 2017 is comprised of all state and local taxes paid by the industry. As such, it would include all government revenue from property taxes, sales taxes, corporate income taxes, electricity excise taxes, license fees, and all other applicable taxes at both the state and the local levels. We do not have data to disaggregate this overall state and local tax estimate.

In addition to providing capital improvements that add to Illinois' tax base, this capital investment also fuels an on-going demand for data center construction. Moreover, in areas such as the Northeast Region it is often the case that that demand leads to the formation of stable and significant industry clusters that support the very specialized construction needs of the data center industry. This characteristic of the data center industry has particular relevance for Illinois, where employment growth in the state's construction sector has lagged behind the national norm in recent years.

Today, 30 states have incentives that are specifically targeted at attracting data centers. Illinois is surrounded by states that offer data center incentives. Data centers follow incentives and will avoid locating in states without incentives. There are lessons to be learned from the years of experience that numerous states have had with data center incentives.

First, as the experience of Chicago and Illinois illustrates, some colocation data centers will be located in every major metropolitan area in order to serve the needs of businesses that must have data located nearby. However, without incentives, the only data centers that will be built in areas without incentives are those that cannot serve the needs of clients if they are built in other areas with incentives. In general, giant, rural data centers will only be located where there are tax incentives because those facilities are very sensitive to cost and not very sensitive to proximity to business locations or large populations of users.

Secondly, no state has a natural lock on attracting data centers. The experience of New York, Virginia, and Washington prove that. For example, the state of Washington would seem to be the obvious, natural choice for Microsoft's data centers because the company is headquartered in the state. However, when Washington legislators decided that they didn't need data center incentives to attract data centers to the state, Microsoft and other firms located their data centers in other states. And the current incentive in the State of Washington has created a colocation data center boom in Hillsboro, Oregon (near the border with Washington) where data centers can serve clients in both Oregon and Washington while taking advantage of the lower tax environment in Oregon.

Finally, it is a mistake to think that giving tax incentives to data centers that locate in a state represent a "loss" for the state. If that were true, then the states where the data centers didn't locate would "gain." What has Illinois "gained" by not having a data center incentive, while 30 other states have enacted incentives. The only thing that the "losing" states "gain" in these situations is a smaller industrial base and a reputation for not being business-friendly.

According to Forbes, "Illinois is home to 68 of the 1,000 biggest companies in the U.S. by revenue—fourth most among states. They include Boeing, Abbott Labs, Caterpillar and Kraft Foods. However, the net migration rate out of Illinois over the last five years is the worst in the U.S." Illinois fares especially poorly, with a grade of F (rank 47), in the "Business Friendliness" category. According to the popular business climate rankings Indiana, Wisconsin, Iowa and Missouri outrank Illinois not only in the overall rankings but especially in the subcategories "Cost of Doing Business / Business Costs" and "Business Friendliness / Regulatory Environment", in which Indiana scores especially well.

It is not a coincidence that workers recently broke ground for a data center in Hammond, Indiana. There are plans to expand the project to a total of $200 million of data center space. According to the Chicago Tribune, the site was selected for the data center project because of its proximity to Chicago and the "tax-friendliness" of Indiana. Though the project is not that large, it could be a harbinger of more data center development on the significant amount of underutilized property in Hammond, East Chicago, and Gary, Indiana. Significant data center development in the Indiana suburbs of Chicago would likely slow growth in the Illinois suburbs of Indiana.

Last summer Apple announced that it would build a 400,000 square foot data center on a 2,000-acre parcel of land in Waukee, Iowa. The cost of construction was announced at $1.375 billion, and Apple committed to employ 50 full-time workers. If incentives attracted a data center like that to rural or suburban Illinois, the statewide impact would be 3,360 additional jobs, $203.9 million in additional labor income, and $521.7 million in new economic output. Such economic activity would also responsible for generating a total of approximately $66.7 million in tax revenue in 2018, of which $20.2 million would be state and local tax revenue.

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NORTHERN VIRGINIA TECHNOLOGY COUNCIL

THE IMPACT OF DATA CENTERS ON THE STATE AND LOCAL ECONOMIES OF VIRGINIA

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About Mangum Economics, LLC

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

POLICY ANALYSIS

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

ECONOMIC IMPACT ASSESSMENTS AND RETURN ON INVESTMENT ANALYSES

Measure the economic contribution that businesses and other enterprises make to their localities.

WORKFORCE ANALYSIS

Project the demand for, and supply of, qualified workers.

CLUSTER ANALYSIS

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

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About the Northern Virginia Technology Council

The Northern Virginia Technology Council (NVTC) is the regional voice of technology, representing a diverse and thriving technology ecosystem, promoting innovation, and convening, educating, and advocating for the region's technology community.

NVTC is the membership and trade association for the technology community in Northern Virginia. As the largest technology council in the nation, NVTC serves about 1,000 companies and organizations, including businesses from all sectors of the technology industry, service providers, universities, foreign embassies, non-profit organizations and government agencies. Through its member companies, NVTC represents about 300,000 employees in the region. NVTC provides its members with:

- Over 150 networking and educational events per year.
- Comprehensive member benefit services.
- Public policy advocacy on a broad range of technology issues at the state and regional levels, with involvement in federal issues as they relate to workforce and education concerns.
- Community service opportunities through involvement in community projects and philanthropy.

NVTC's Data Center and Cloud Committee provides a clear, consistent, collective and compelling voice for promoting the interests of the region's growing data center, cloud, and critical infrastructure community to contribute to the long-term growth and prosperity of the industry. The committee:

- Promotes the interests of anyone with a stake in ensuring that Northern Virginia continues to be a leading global destination not just for data centers but also for the wider ecosystem that relies on the data center as the commerce platform of the 21st century.
- Provides educational and training programming for its members and provides forums for thought leadership and the sharing of best practices.
- Leads efforts to identify the needs of the future workforce and advocates for industry-specific education programming.
- Informs the community of the industry's vital role as a contributor to today's technology-led economy and a major factor in the prosperity and economic stability of the region.
- Works to ensure the sustainability of the industry by thoughtfully discussing potential barriers to growth and acts as an advocate for policies that prompt the overall health of the industry.
- Addresses the short- and long-term competitiveness of the data center industry in Virginia.
- Bolsters the data center and critical infrastructure industry through public policy advocacy.
- Promotes initiatives to increase data center investment and expansion throughout Virginia.

Acknowledgements

This report was made possible in part by the unique data supplied by the Loudoun County Department of Economic Development (especially, Alex Gonski and Buddy Rizer), the Prince William County Department of Economic Development (especially, Allisha Abraham, Thomas Flynn, and Jim Gahres), and the Virginia Economic Development Partnership (especially, Brian Kroll).

Executive Summary

Northern Virginia is the largest data center market in the world, but the data center industry has an important footprint in every part of the Commonwealth of Virginia. Central Virginia and Hampton Roads each account for almost ten percent of overall industry employment in the state. Data center industry pay has increased twice as fast as the statewide average since 2001.

We estimate that in 2018 the data center industry in Virginia directly provided approximately:

- 14,644 full-time-equivalent jobs with an average annual pay of $126,000,
- $1.9 billion in associated pay and benefits, and
- $4.5 billion in economic output.

Taking into account the economic ripple effects that direct investment generated, we estimate that the total impact on Virginia from the data center industry in 2018 was approximately:

- 45,290 full-time-equivalent jobs,
- $3.5 billion in associated pay and benefits, and
- $10.1 billion in economic output.

Data centers pay millions of dollars in state and local taxes in Virginia, even though Virginia has a sales and use tax exemption on some equipment for data centers that are large enough to qualify for the exemption. In addition to the taxes paid directly by data centers, local governments and the Commonwealth of Virginia collect tax revenue from the secondary indirect and induced economic activity that data centers generate. We estimate that in 2018, data centers were directly and indirectly responsible for generating $600.1 million in state and local tax revenue in Virginia.

At the local level data centers provide far more in county or city tax revenue than they and their employees demand in local government services. For example, we estimate that for every dollar in county expenditures that the data center industry caused in 2018, it generated:

- $8.60 in local tax revenue in Henrico County, and property taxes there would have had to rise by 1 percent without the data center induced tax revenue.
- $15.10 in local tax revenue in Loudoun County, and property taxes there would have had to rise by 21 percent without the data center induced tax revenue.
- $17.80 in tax revenue in Prince William County, and property taxes there would have had to rise by 7 percent without the data center induced tax revenue.

In June of 2019, Virginia's Joint Legislative Audit and Review Commission (JLARC) published an evaluation of the state's data center sales and use tax incentive. JLARC found that 90 percent of the data center investment made by the companies that received the sales and use tax exemption would not have occurred in the state of Virginia without the incentive. Instead, that data center investment would have occurred in other states. So, the "cost" of the State data center incentive is only 10 percent of the amount of State sales tax revenue exempted. In fact, in 2017, the data center tax incentive generated

$1.09 of State tax revenue for every dollar that it exempted; and in 2016, the incentive was revenue neutral. Since 2013, after the General Assembly significantly revised the Virginia data center incentive, the State has recovered 75 cents of every dollar of potential tax revenue that it exempted. In the process it created thousands of Virginia jobs with billions of dollars in pay and benefits and billions of dollars in economic activity throughout the state.

Virginia is one of 31 states that actively offer incentives to attract data centers to locate in their states. Several states are in the process of revising their incentives to remain competitive. Virginia's data center incentive is one of the most restrictive in the country. Of the 31 states that actively offer data center incentives, only 11 require a minimum number of new jobs to qualify for an incentive, and only Virginia, Mississippi, and Nevada require the creation of 50 or more new jobs.

Virginia's data center incentive has been important in the spread of technology industries across the Commonwealth and in attracting smaller data centers that do not qualify for the incentive to invest in the state as well. Recently several localities have reduced their local property tax rates in order to attract data centers to support their economies.

Introduction to Data Centers in Virginia

Life is increasingly digitized, and our digitized lives are stored, secured, processed, enhanced, and distributed by data centers. Our finances, communications, health care, recreation, entertainment, education, transportation, work, and social lives are often and increasingly online. Data centers are more than just the redundant warehouses for our digital lives. They are also the generators of much of the interactive digital content that we use. The personalized shopping recommendations; the on-the-fly driving directions; the online assistance selecting a restaurant, hotel, plane flight; the digital grocery coupons; the machine responses to banking and billing inquiries, etc. are all provided by data centers.

In 2012, IBM published an estimate that 90 percent of all data have been created in the last two years.[1] In other words, at that time, the total amount of data was increasing by ten times every two years. At that rate, from 2010 to 2020 the total amount of data has increased by 100,000 times. Now consider that the IBM estimate was made prior to the widespread adoption of commercial connected sensors and smart consumer appliances. The expansion of artificial intelligence, machine learning, and augmented reality are all putting increasing demands on data centers. So, it is quite likely that the rate of growth of data is even greater than in 2012. We have not yet reached "peak data center."

In addition, with the rollout of 5G technology to wireless networks, the shape of the industry will change. Edge data centers that are relatively smaller than large cloud data centers will need to be located near places where people congregate and move. However, edge data centers will not be substitutes for large enterprise data centers or cloud data centers. Instead, edge data centers will be constructed as a complement to large data centers as the data center industry continues to grow and evolve to meet the demands of new technology.

Because data centers use large amounts of costly electricity and water, they have emerged as leading innovators at the forefront of increasing operational efficiency in the use of energy and water.[2] Among other innovations, data centers have used digitization, advanced sensors, and machine learning (within data centers) to dramatically reduce energy and water consumption. For example, Google has been able to reduce the amount of energy used for cooling in its data centers by up to 40 percent, reducing overall energy usage in its data centers by 15 percent on top of previous efficiency enhancements.[3] Data center companies have also made large commitments to the purchase of energy from renewable sources here in Virginia and nationwide. For utility companies to move to different and initially costlier sources of renewable power, they need this kind of commitment to provide a stable demand to ensure that the large upfront investments that are required are financially sustainable.

This report quantifies the significant contribution that this dynamic and rapidly evolving industry makes to the state of Virginia and its localities.

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[1] David Greer, "System z Helps Address the Data Analytics Power Crunch," *IBM Systems magazine*, April 2012.
[2] https://www.osti.gov/servlets/purl/1372902/
[3] https://deepmind.com/blog/article/deepmind-ai-reduces-google-data-centre-cooling-bill-40

ECONOMIC PROFILE OF DATA CENTERS IN VIRGINIA

Virginia now has data centers located throughout the state, from Wise County in Southwestern Virginia and Harrisonburg in the Valley to Mecklenburg County in Southern Virginia, Virginia Beach in Hampton Roads, and Henrico County in Central Virginia to Loudoun County in Northern Virginia, and other localities. This report shows how the data center industry in every part of the state makes an important economic contribution to employment and taxes in every region and to the state as a whole. However, we begin with an update on the remarkable data center market in Northern Virginia.

The Northern Virginia Data Center Market in 2019

Northern Virginia has the largest data center market in the world. According to the latest data from CBRE[4], measured in megawatts (MW) of power capacity, Northern Virginia has more data center inventory than the 6th through the 15th largest markets (New York Tri-State, Atlanta, Austin-San Antonio, Houston, Southern California, Seattle, Denver, Boston, Charlotte-Raleigh, and Minneapolis) combined and almost as much as the 2nd, 3rd, 4th and 5th largest markets (Dallas-Fort Worth, Silicon Valley, Chicago, and Phoenix) combined.

The large capacity of Northern Virginia's data center market is matched by its growth. Twenty-two percent of the total data center capacity in Northern Virginia was added between the second half of 2018 and the first half of 2019.

The growth in the Northern Virginia data center market has not only served technology, data center, and data dependent companies, but construction companies.

Northern Virginia's place at the top of the data center market is a relatively recent development. In 2016, Northern Virginia had just supplanted the New York market as the largest data center market in the United States. In 2017, the New York Tri-State area had fallen to the sixth largest data center market. A 2011 report on the data center market in the United States contains only one mention of Virginia in four pages – "Reston, VA has excess supply and new construction will be minimal for a few years."[5] The locations that were highlighted as important in the industry were Chicago, Silicon Valley, Southern California, Phoenix, New York, St. Louis, Washington State, Boston, Minneapolis, Denver, and Charlotte. Regarding what has become the second largest data center market, the report says, "Dallas has excess capacity and growth remains slow."

This illustrates the fluid nature of the data center industry and the speed with which market conditions can change in the industry. Once hot markets can cool off rapidly. A year ago, the data center market in Phoenix had enormous growth, but between the second half of 2018 and the first half of 2019, Phoenix saw net outflows of 26.5 MW worth of tenants, which is almost the same amount that Northern Virginia

[4] CBRE, *Large Supply Pipeline Sets Stage for Market Growth in 2019 North American Data Center Report H1 2019*.
[5] ESD (Environmental Systems Design, Inc.), *2011 Data Center Technical Market Report*. February 2011.

added in the same period.[6] The computer equipment in data centers is replaced on average every three years. Should circumstances require it, data center tenants can move from one location to another and leave significant vacancies in colocation data centers.

Figure 1 shows the top 15 largest data center markets in the United States. The area of each circle indicates the relative amount of power capacity (MW labeled in black) in each market. Brighter blue circles indicate markets with higher occupancy rates, with Austin-San Antonio, Silicon Valley, and Northern Virginia having occupancy rates of about 96 to 93 percent (in order of occupancy).

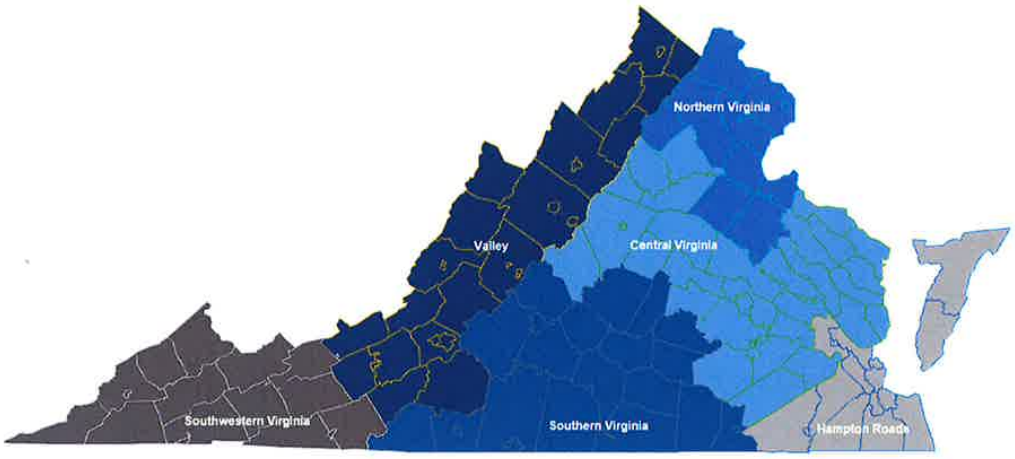
Figure 1. Relative Sizes of Largest Data Center Markets (megawatts of power capacity) – 2019[7]

[6] CBRE, *Large Supply Pipeline Sets Stage for Market Growth in 2019 North American Data Center Report H1 2019.*
[7] CBRE, *Large Supply Pipeline Sets Stage for Market Growth in 2019 North American Data Center Report H1 2019.*

The Regional Distribution of Data Centers in Virginia

The Virginia Economic Development Partnership (VEDP) provided data on the private sector Data Processing, Hosting, and Related Services industry (as defined by the U.S. Bureau of Labor Statistics) for this economic profile.[8] VEDP divided the statewide data into six sub-state regions depicted in Figure 2.

Figure 2. Six Sub-State Regions Defined by the Virginia Economic Development Partnership

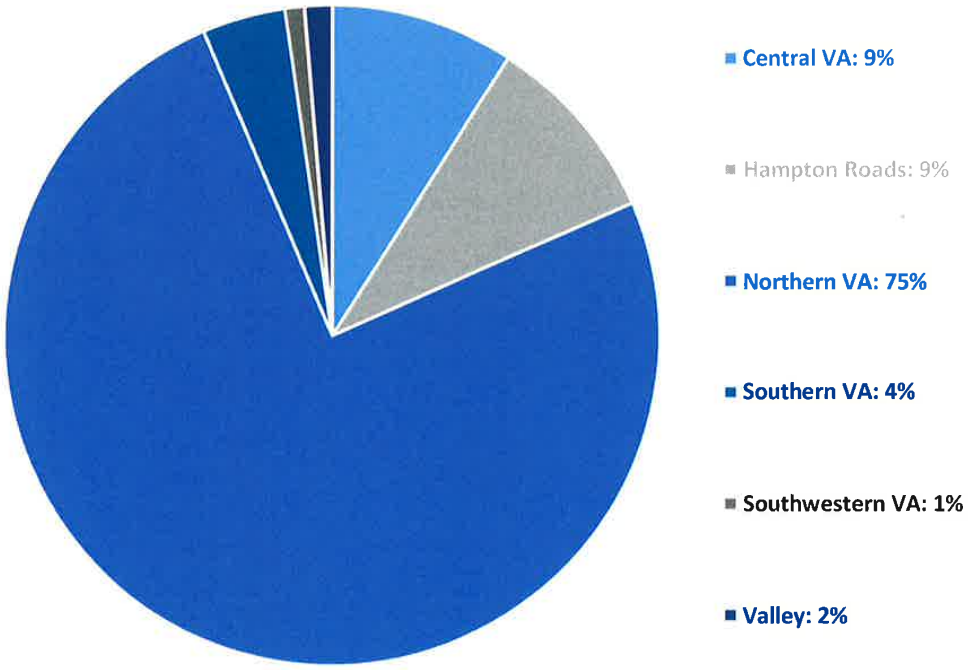


According to VEDP, in 2018, the private sector data center industry employed 14,644 people (full-time equivalents) statewide.

[8] As is common practice, we use the Data Processing, Hosting, and Related Services industry as defined by the U.S. Bureau of Labor Statistics as a proxy for the data center industry. The data and methods applied in this report are described in the separate accompanying Appendix.

Figure 3 shows the regional distribution of that employment. Seventy-five percent of data center employment was located in Northern Virginia. However, industry employment was distributed across other regions of the Commonwealth, as well. Central Virginia and Hampton Roads accounted for nine percent of data center jobs each. Southern Virginia (home to Microsoft's Boydton data center campus, the east coast hub for Microsoft Azure) accounted for four percent of private sector data center employment, one percent of industry employment was in Southwestern Virginia, and two percent was in the Valley.

Figure 3. Regional Distribution of Private Sector Data Center Employment in Virginia in 2018[9]



The Upward Trend in Virginia's Data Center Industry

Data center employment in Virginia generally declined between 2004 and 2012, but it has since escalated rapidly to 14,644 jobs in 2018.[10] That change to the uptrend in employment that began in 2012 coincides with the year that Virginia significantly revised its data center incentive to make it more competitive with other states in attracting data centers. More detail on the employment trends in the industry is included in the separate Appendix that accompanies this report.

[9] Data Source: Virginia Economic Development Partnership.
[10] Data Source: Virginia Economic Development Partnership.

The High-Performance Data Center Industry in Virginia

One of the key characteristics of the data center industry is that it is extremely capital intensive. In other words, the industry employs a relatively small number of highly skilled and highly paid people to operate and maintain a very large amount of very expensive equipment. Therefore, it is useful to also look at trends in private sector average annual wages in the industry.

Between 2001 and 2018 the average annual private sector wage in the data center industry in Virginia grew from $61,310 to $126,050 – a 106 percent increase.[11] In comparison, over the same period average private wages across all industries in Virginia went from $36,525 to $57,846 – an increase of 58 percent.[12] In other words, over the 18-year period, the average private sector employee of a Virginia data center saw their gross income go up almost twice as fast as the average private sector employee in Virginia. More detail on the employment trends in the industry is included in the separate Appendix that accompanies this report.

This combination of steadily rising employment and rapidly rising wages make the data center industry one of Virginia's most high-performance industries and an important (and growing) contributor to a strong and robust state economy. Moreover, in a state such as Virginia where roughly two-thirds of state revenue comes from personal income tax, high growth/high wage industries such as the data center industry also play a disproportionate role in ensuring the health of the State's budget.

The Impact of Data Centers on Virginia State and Local Economies

The construction and ongoing operation of data centers in Virginia has large, broad effects across the state economy. In this section, we estimate the statewide economic impact that the data center industry has on Virginia, as well as in each of the six sub-state regions detailed earlier. To empirically evaluate the statewide and regional economic impact attributable to the data center industry, we employ a commonly used regional economic impact model called IMPLAN Pro.[13] The methodology for modeling the economic impact of data centers is explained in more detail in the separate Appendix that accompanies this report.

Regional economic impact modeling measures the ripple effects that an expenditure generates as it makes its way through the economy. For this report, spending by the data center industry in Virginia has a direct economic impact on the state economy in terms of people hired as data center employees, employee pay and benefits, and economic activity in the region for utilities, construction, and equipment. That direct spending by the data centers creates the first ripple of economic activity.

[11] Data Source: Virginia Economic Development Partnership.
[12] Data Source: U.S. Bureau of Labor Statistics.
[13] IMPLAN Pro is produced by IMPLAN Group, LLC.

As data center employees and businesses (like construction contractors for data centers, power companies that supply data centers, and data center equipment suppliers) spend the money that they were paid by data center companies, they create another *indirect* ripple of economic activity that is part of the second-round effects of the data center industry.

There are many Virginia businesses that are part of the data center supply chain. To illustrate some of the types of companies located in Virginia that benefit from the data center industry in Virginia and that, in turn, generate economic activity in the state, in Table 1 we list a few different types of businesses in the Virginia data center supply chain. The list of businesses in Table 1 is not an endorsement, promotion, or commendation of them, and it is far from a complete list of companies. We only provide it to illustrate some of the types of businesses that are part of the second ripple effect of economic activity related to spending by data centers.

Table 1. Some Businesses Serving Virginia Data Centers

Company	Line of Business
Anord Mardix	data center power distribution and management products and services
Compu Dynamics	data center design, construction, optimization, and maintenance
Fulcrum Collaborations	data center facilities management cloud-based platform
Hanley Energy	data center energy management services
Interglobix	data center and fiber interconnectivity consulting and marketing
Metro Fiber Networks	carrier-neutral fiber connecting Virginia Beach to Henrico data centers
Power Distribution Incorporated	data center power transformation, distribution, and monitoring
Rosendin Electric	data center design and construction services
Submer	data center IT hardware immersion cooling
Technoguard	data center materials, cleaning, decontamination, and disaster recovery
Timmons Group	data center site certification and development
Windward Consulting	data center management consulting

In addition to the economic effects in the Virginia state and local economies of the data center-to-other business transactions, there are also the second-round economic effects associated with data center employee-to-business transactions that ripple through local economies. These effects occur when data center employees buy groceries; pay rent; go out for dinner, entertainment, or other recreation; pay for schooling in Virginia; or make other local purchases. Additionally, there are the second-round economic effects of business-to-business transactions between the direct vendors to data centers and their suppliers.

The total impact is simply the sum of the first round direct and second round impacts. These categories of impact are then further defined in terms of employment (the jobs that are created), labor income (the pay and benefits associated with those jobs), and economic output (the total amount of economic activity that is created in the economy).

VIRGINIA STATEWIDE

We estimate that in 2018 the data center industry in Virginia directly provided approximately:

- 14,644 full-time-equivalent jobs,
- $1.9 billion in associated employee pay and benefits, and
- $4.5 billion in economic output.

Taking into account the economic ripple effects generated by that direct impact, we estimate that the total impact on Virginia from the data center industry in 2018 was approximately:

- 45,290 full-time-equivalent jobs,
- $3.5 billion in associated employee pay and benefits, and
- $10.1 billion in economic output.

Table 2. Economic Impact of the Data Center Industry in Virginia in 2018 (2018 dollars)

1st Round Direct Effects	Jobs	Pay	Economic Output
Data Centers	14,644[14]	$1,908,963,000	$4,541,390,000
2nd Round Indirect and Induced Effects[15]			
Operations	23,796	$1,223,797,000	$4,566,184,000
Healthcare	1,932	$152,433,000	$292,468,000
Construction	4,918	$263,018,000	$690,126,000[16]
Total Impact			
Total Economic Impact in Virginia Statewide[17]	**45,290**	**$3,548,212,000**	**$10,090,168,000**

[14] Data Source: Virginia Economic Development Partnership.
[15] The methodology for estimating and characterizing 2nd round effects is described in detail in the separate Appendix that accompanies this report.
[16] Derived from Virginia Economic Development Partnership Announcements.
[17] The statewide estimates of jobs, pay, and economic output is larger than the sum of the individual regional estimates reported separately in the following tables because the regional totals only register jobs, pay, and economic output in a region caused by the direct data center investment in the same region. The regional amounts do not count jobs, pay, and economic output generated in one region caused by direct data center investment that occurred in another region.

CENTRAL VIRGINIA

We estimate that in 2018 the data center industry in Central Virginia directly provided approximately:

- 1,275 full-time-equivalent jobs,
- $141.5 million in associated employee pay and benefits, and
- $341.4 million in economic output.

Taking into account the economic ripple effects generated by that direct impact, we estimate that the total impact on Central Virginia from the data center industry in 2018 was approximately:

- 5,248 full-time-equivalent jobs,
- $347 million in associated employee pay and benefits, and
- $1 billion in economic output.

Table 3. Economic Impact of the Data Center Industry in Central Virginia in 2018 (2018 dollars)

1st Round Direct Effects	Jobs	Pay	Economic Output
Data Centers	1,275[18]	$141,500,000	$341,382,000
2nd Round Indirect and Induced Effects[19]			
Operations	2,042	$105,729,000	$407,868,000
Healthcare	144	$11,812,000	$22,584,000
Construction	1,787	$87,949,000	$244,267,000[20]
Total Impact			
Total Economic Impact in Central Virginia	**5,248**	**$346,990,000**	**$1,016,102,000**

[18] Data Source: Virginia Economic Development Partnership.
[19] The methodology for estimating and characterizing 2nd round effects is described in detail in the separate Appendix that accompanies this report.
[20] Derived from Virginia Economic Development Partnership Announcements.

HAMPTON ROADS

We estimate that in 2018 the data center industry in Hampton Roads directly provided approximately:

- 1,322 full-time-equivalent jobs,
- $72.6 million in associated employee pay and benefits, and
- $329.4 million in economic output.

Taking into account the economic ripple effects generated by that direct impact, we estimate that the total impact on Hampton Roads from the data center industry in 2018 was approximately:

- 3,510 full-time-equivalent jobs,
- $166.2 million in associated employee pay and benefits, and
- $667.6 million in economic output.

Table 4. Economic Impact of the Data Center Industry in Hampton Roads in 2018 (2018 dollars)

1st Round Direct Effects	Jobs	Pay	Economic Output
Data Centers	1,322[21]	$72,565,000	$329,362,000
2nd Round Indirect and Induced Effects[22]			
Operations	1,804	$73,436,000	$287,200,000
Healthcare	76	$5,466,000	$10,764,000
Construction	309	$14,775,000	$40,288,000[23]
Total Impact			
Total Economic Impact in Hampton Roads	**3,510**	**$166,241,000**	**$667,614,000**

[21] Data Source: Virginia Economic Development Partnership.
[22] The methodology for estimating and characterizing 2nd round effects is described in detail in the separate Appendix that accompanies this report.
[23] Derived from Virginia Economic Development Partnership Announcements.

NORTHERN VIRGINIA

We estimate that in 2018 the data center industry in Northern Virginia directly provided approximately:

- 10,663 full-time-equivalent jobs,
- $1.6 billion in associated employee pay and benefits, and
- $3.5 billion in economic output.

Taking into account the economic ripple effects generated by that direct impact, we estimate that the total impact on Northern Virginia from the data center industry in 2018 was approximately:

- 28,196 full-time-equivalent jobs,
- $2.6 billion in associated employee pay and benefits, and
- $6.9 billion in economic output.

Table 5. Economic Impact of the Data Center Industry in Northern Virginia in 2018 (2018 dollars)

1st Round Direct Effects	Jobs	Pay	Economic Output
Data Centers	10,663[24]	$1,554,239,000	$3,517,485,000
2nd Round Indirect and Induced Effects[25]			
Operations	13,692	$786,373,000	$2,744,347,000
Healthcare	1,397	$121,517,000	$221,932,000
Construction	2,445	$163,753,000	$382,561,000[26]
Total Impact			
Total Economic Impact in Northern Virginia	**28,196**	**$2,625,883,000**	**$6,866,325,000**

The Northern Virginia Community College Programs

Northern Virginia Community College (NOVA) has developed programs to help address the challenges that data centers in the Northern Virginia area have meeting their staffing needs. Amazon Web Services (AWS) has a paid apprenticeship program at the NOVA.[27] In December 2018, the program graduated its first students into full-time Associate Cloud Consultant jobs with AWS.

NOVA also has a 2-year Associate of Applied Science program to train Datacenter Operations Technicians.[28] The program includes lab training at a training data center that the State of Virginia built on the NOVA-Loudoun Campus. The program started with 19 students in its very first year, almost half of them have already found internships or full-time jobs in Northern Virginia data centers or full-time jobs with companies that work for data centers.

[24] Data Source: Virginia Economic Development Partnership.
[25] The methodology for estimating and characterizing 2nd round effects is described in detail in the separate Appendix that accompanies this report.
[26] Derived from Virginia Economic Development Partnership Announcements.
[27] NOVA, "Amazon and Northern Virginia Community College Announce Graduation of the First Veteran Technical Apprenticeship Cohort on the East Coast," December 12, 2018.
[28] NOVA 2019-2020 Catalog, Engineering Technology: Data Center Operations Specialization, A.A.S.

SOUTHERN VIRGINIA

We estimate that in 2018 the data center industry in Southern Virginia directly provided approximately:

- 568 full-time-equivalent jobs,
- $33 million in associated employee pay and benefits, and
- $137.2 million in economic output.

Taking into account the economic ripple effects generated by that direct impact, we estimate that the total impact on Southern Virginia from the data center industry in 2018 was approximately:

- 1,236 full-time-equivalent jobs,
- $57.5 million in associated employee pay and benefits, and
- $237.4 million in economic output.

Table 6. Economic Impact of the Data Center Industry in Southern Virginia in 2018 (2018 dollars)

1st Round Direct Effects	Jobs	Pay	Economic Output
Data Centers	568[29]	$33,030,000	$137,223,000
2nd Round Indirect and Induced Effects[30]			
Operations	637	$22,286,000	$96,006,000
Healthcare	32	$2,228,000	$4,159,000
Construction[31]			
Total Impact			
Total Economic Impact in Southern Virginia	**1,236**	**$57,544,000**	**$237,388,000**

[29] Data Source: Virginia Economic Development Partnership.
[30] The methodology for estimating and characterizing 2nd round effects is described in detail in the separate Appendix that accompanies this report.
[31] VEDP registered no data center investment announcements in 2018 in Southern Virginia, and therefore we do not estimate construction activity in the area. However, it is important to note that we attribute construction only to the first year of an announcement and, unlike ongoing data center operations, construction is episodic. For example, we estimate that as recently as 2016, Southern Virginia enjoyed approximately $50 million in data center construction. This estimate may actually understate the actual economic impact of data center construction.

SOUTHWESTERN VIRGINIA

We estimate that in 2018 the data center industry in Southwestern Virginia directly provided approximately:

- 135 full-time-equivalent jobs,
- $8.6 million in associated employee pay and benefits, and
- $28.9 million in economic output.

Taking into account the economic ripple effects generated by that direct impact, we estimate that the total impact on Southwestern Virginia from the data center industry in 2018 was approximately:

- 257 full-time-equivalent jobs,
- $13.1 million in associated employee pay and benefits, and
- $45.8 million in economic output.

Table 7. Economic Impact of the Data Center Industry in Southwestern Virginia in 2018 (2018 dollars)

1st Round Direct Effects	Jobs	Pay	Economic Output
Data Centers	135[32]	$8,552,000	$28,869,000
2nd Round Indirect and Induced Effects[33]			
Operations	113	$3,940,000	$15,787,000
Healthcare	8	$532,000	$1,031,000
Construction	1	$27,000	$80,000[34]
Total Impact			
Total Economic Impact in Southwestern Virginia	**257**	**$13,051,000**	**$45,767,000**

[32] Data Source: Virginia Economic Development Partnership.
[33] The methodology for estimating and characterizing 2nd round effects is described in detail in the separate Appendix that accompanies this report.
[34] Derived from Virginia Economic Development Partnership Announcements. However, it is important to note that we attribute construction only to the first year of an announcement and, unlike ongoing data center operations, construction is episodic. This estimate may actually understate the actual economic impact of data center construction.

VALLEY

We estimate that in 2018 the data center industry in the Valley directly provided approximately:

- 191 full-time-equivalent jobs,
- $14.3 million in associated employee pay and benefits, and
- $46.1 million in economic output.

Taking into account the economic ripple effects generated by that direct impact, we estimate that the total impact on the Valley from the data center industry in 2018 was approximately:

- 461 full-time-equivalent jobs,
- $24.9 million in associated employee pay and benefits, and
- $86.6 million in economic output.

Table 8. Economic Impact of the Data Center Industry in the Valley in 2018 (2018 dollars)

1st Round Direct Effects	Jobs	Pay	Economic Output
Data Centers	191[35]	$14,255,000	$46,088,000
2nd Round Indirect and Induced Effects[36]			
Operations	255	$9,555,000	$38,439,000
Healthcare	15	$1,046,000	$2,041,000
Construction[37]			
Total Impact			
Total Economic Impact in the Valley	**461**	**$24,856,000**	**$86,568,000**

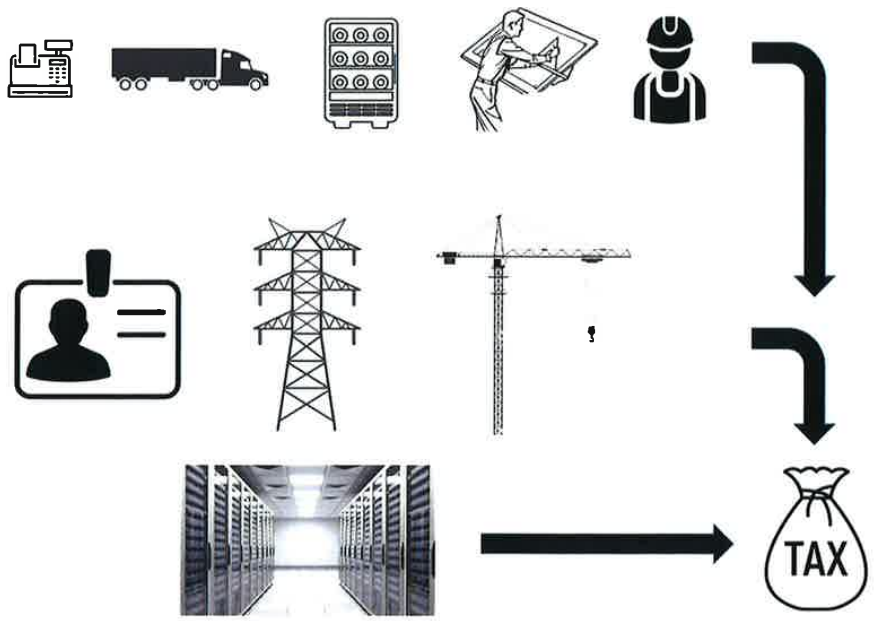
[35] Data Source: Virginia Economic Development Partnership.
[36] The methodology for estimating and characterizing 2nd round effects is described in detail in the separate Appendix that accompanies this report.
[37] No data center investment announcements were made in 2018 in the Valley. However, it is important to note that we attribute construction only to the first year of an announcement and, unlike ongoing data center operations, construction is episodic. This estimate may actually understate the actual economic impact of data center construction.

State and Local Taxes Generated by Data Centers in Virginia

Data centers pay millions of dollars in state and local taxes in Virginia, even though Virginia has a sales and use tax exemption on some equipment for data centers that are large enough to qualify for the exemption. All data centers (large and small) pay state employer withholding taxes and corporate income tax. At the local level, both large and small data centers pay real estate taxes, tangible personal property taxes, business license taxes, and industrial utilities taxes. Additionally, many data centers still must pay state sales and use taxes on their purchases of data center equipment because they are not large enough to qualify for the Virginia data center incentive.

In addition to the taxes that data centers pay directly, the economic activity that they generate also results in additional tax collections. Figure 4 illustrates the sources of tax revenues associated with data centers. On the bottom row, data centers pay taxes directly to federal, state, and local governments. On the second row, the employees and business suppliers that are paid directly by the data centers also pay taxes; and, additionally, on the third row, the people and businesses that are paid by the employees and suppliers of data centers pay taxes. All of these sources of tax revenue are included in the tax revenue estimates described in this report.

Figure 4. Sources of Tax Revenue Associated with Data Centers



STATEWIDE AND REGIONAL TAX COLLECTIONS ASSOCIATED WITH DATA CENTERS

In addition to the taxes paid directly by data centers, local governments and the Commonwealth of Virginia collect tax revenue from the secondary indirect and induced economic activity that data centers generate. Table 9 shows our estimates of the taxes directly and indirectly generated by the data center industry statewide in Virginia and in each of the six sub-state regions in 2018 through that first round and second round economic activity.

We estimate that in 2018, data centers were directly and indirectly responsible for generating $600.1 million in state and local tax revenue in Virginia.

Table 9. Tax Revenue Directly and Indirectly Generated by the Data Centers Industry in Virginia in 2018

Region	State and Local Taxes Collected	Federal Taxes Collected	Total Taxes Collected
Central Virginia	$37,231,000	$83,069,000	$120,300,000
Hampton Roads	$21,260,000	$38,624,000	$59,885,000
Northern Virginia	$460,534,000	$587,517,000	$1,048,051,000
Southern Virginia	$7,823,000	$13,643,000	$21,466,000
Southwestern Virginia	$1,469,000	$2,945,000	$4,414,000
Valley	$2,985,000	$5,745,000	$8,731,000
Virginia Statewide[38]	**$600,120,000**	**$812,308,000**	**$1,412,428,000**

CONTRIBUTION TO LOCAL GOVERNMENT BUDGETS

Because the data centers need more equipment and utilities than they need employees, the data center industry provides a large amount of property tax revenue for local governments. Additionally, the industry also places downward pressure on overall tax rates, thereby improving the locality's business climate and economic attractiveness.

High Local Benefit to Cost Ratio

Data centers provide a high benefit to cost ratio in terms of the tax revenue they generate relative to the government services that they and their employees require. Loudoun County, Prince William County, and Henrico County are home to the most significant concentrations of data centers in Virginia. County staff in those localities were able to provide us with detailed data on the tax revenue generated by this industry in each locality from real and business personal property taxes.[39] As a result, we are able

[38] The statewide estimates of taxes collected is larger than the sum of the taxes collected in the individual regions separately because the regional totals only register tax revenue in a region caused by the direct data center investment in the same region. The regional amounts do not count taxes generated in one region caused by direct data center investment that occurred in another region.

[39] It should be noted that, of necessity, these estimates exclude BPOL and other local taxes that also apply to the data center industry. As a result, the revenue estimates provided almost certainly under-estimate the actual local tax revenues of the data center industry.

to use those data in combination with data from other sources to compute the benefit to cost ratio associated with the data center industry in each locality.

To quantify the budgetary cost that the data center industry and its employees imposed on these localities in 2018, we use data from the Virginia Department of Education on local elementary and secondary education expenditures per student, and data from the Virginia Auditor of Public Accounts on local non-education expenditures per county resident. This approach focuses on the largest costs that any business imposes on a local government – the costs associated with providing primary and secondary education, and other county services, to the employees of that business.

Table 10 details the calculations used to estimate the budgetary cost that the data center industry and its employees imposed on each of these three counties in 2018. As shown, we estimate those costs to be approximately $400,000 in Henrico County, $17.7 million in Loudoun County, and $2 million in Prince William County.

Table 10. Estimate of Total Budgetary Costs Imposed by the Data Center Industry and Employees in 2018

	Henrico County	Loudoun County	Prince William County
County Private Sector Employment in Data Processing, Hosting, and Related Services in 2018[40]	115	2,278	241
Students per Employee[41]	0.27	0.48	0.69
Per Student County Education Expenditures[42]	$4,852	$10,069	$5,296
Total Education Costs[43]	**$150,000**	**$11,005,000**	**$886,000**
County Residents per Employee[44]	1.72	2.41	3.59
Per Resident Non-Education County Expenditures[45]	$1,477	$1,216	$1,294
Total Non-Education Costs[46]	**$292,000**	**$6,667,000**	**$1,120,000**
TOTAL COSTS[47]	**$442,000**	**$17,672,000**	**$2,006,000**

[40] Data Source: U.S. Bureau of Labor Statistics.
[41] Data Source: Virginia Department of Education and U.S. Bureau of Labor Statistics. Derived by dividing total county elementary and secondary school enrollment in 2018 by total county employment in 2018.
[42] Data Source: Virginia Department of Education.
[43] Calculated as county private sector employment in the data center industry in 2018, times students per employee, times per student education expenditures.
[44] Data Source: U.S. Census Bureau and U.S. Bureau of Labor Statistics. Calculated by dividing total county population in 2018 by total county employment in 2018.
[45] Data Source: Virginia Auditor of Public Accounts and U.S. Census Bureau. Derived by dividing total county non-educational expenditures in 2018 by total county population in 2018.
[46] Derived as county private sector employment in the data center industry in 2018, times county residents per employee, times per resident non-education expenditures.
[47] Derived as the sum of total education costs and total non-education costs.

As shown in Table 11, combining the estimates of budgetary cost from Table 9 with data from each of the localities on the local revenue generated by the data center industry shows that in 2018 the benefit/cost ratio associated with the industry was:

- 8.6 in Henrico County. Which means that for every $1.00 in county expenditures that the data center industry was responsible for generating in 2018, it provided approximately $8.60 in tax revenue.
- 15.1 in Loudoun County. Which means that for every $1.00 in county expenditures that the data center industry was responsible for generating in 2018, it provided approximately $15.10 in tax revenue.
- 17.8 in Prince William County. Which means that for every $1.00 in county expenditures that the data center industry was responsible for generating in 2018, it provided approximately $17.80 in tax revenue.

Table 11. Estimated Benefit/Cost Ratio Associated with the Data Center Industry and Employees in 2018

Locality	Estimated Tax Revenue (Benefit)	Estimated Budgetary Cost	Benefit/Cost Ratio
Henrico County	$3,784,000	$442,000	8.6
Loudoun County	$266,623,000	$17,672,000	15.1
Prince William County	$35,802,000	$2,006,000	17.8

Reduces the Tax Burden on Local Residents and Lowers Tax Rates

One of the most useful concepts in economics is the concept of opportunity cost – what is the cost of not doing something? Or in this case, what would have been the cost to these localities if their data centers had not existed in 2018? The obvious answer is that they would not have received the estimated $306.2 million in county tax revenue that this industry provided in 2018. Therefore, in order to maintain county expenditures at the same level, that revenue would have had to come from other sources. The two most likely sources would have been: 1) additional education funding from the state triggered by the negative impact that this loss in tax base would have had on the composite index formula Virginia uses to allocate education funding to localities, and 2) an increase in each county's real property tax rate.

On average, the state of Virginia funds 55 percent of primary and secondary education expenditures, and localities are required to locally fund the remaining 45 percent.[48] But, that local funding percentage is adjusted up or down based on each locality's "ability to pay" as measured by Virginia's composite index formula that takes into account the locality's property tax base, adjusted gross income, and

[48] In actuality, however, baseline local funding percentages are typically higher than 45 percent because of local initiatives.

taxable retail sales. Of these three factors, property tax base receives the highest weight (50 percent) and, therefore, has the largest influence on the final calculation.[49]

The 2018 composite index for Henrico County was 0.4183, for Loudoun County 0.5383 and for Prince William County 0.3783.[50] If we recalculate those indexes to take into account the loss of tax base implied by the $306.2 million loss in tax revenue that would have occurred if the data center industry had not existed in these localities, those indexes fall to 0.4162, 0.5065, and 0.3692 respectively.

As shown in Table 12, according to our estimates, this means that the state would have had to reallocate $55.8 million in state education funding away from other Virginia localities to provide $1 million in additional formula-driven funding to Henrico County, $44.3 million in additional funding to Loudoun County, and $10.5 million in additional funding to Prince William County.

Table 12. Estimated Additional Revenue Required to Compensate for Loss of the Data Center Industry in 2018 by Source

Locality	Revenue Loss	State Education Funding Off-Set	Additional Local Tax Revenue Required from Other Sources
Henrico County	($3,784,000)	$1,043,000	$2,741,000
Loudoun County	($266,623,000)	$44,285,000	$223,338,000
Prince William County	($35,802,000)	$10,465,000	$25,337,000
Total*	**($306,210,000)**	**$55,794,000**	**$250,416,000**

*May not sum due to rounding

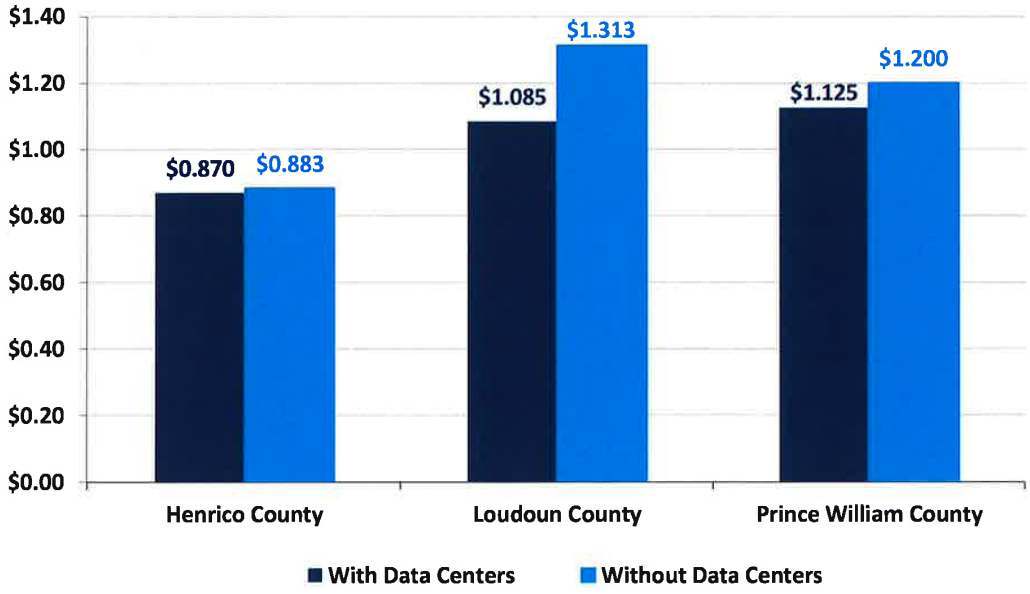
[49] Virginia Department of Education. The actual formula weights each locality's property tax base by 0.5, adjusted gross income by 0.4, and taxable retail sales by 0.1. Each metric is then divided by school population and total population and those per capita figures are divided by the average across all localities to determine ability to pay. The per capita figures are then themselves weighted with each per capita school population metric receiving a weight of 0.66 and each per capita population metric receiving a weight of 0.33.

[50] Virginia Department of Education.

The remaining $250.4 million in lost tax revenue would likely have been made up through increased property taxes (by far the largest source of revenue for most localities). Figure 8 depicts our estimate of the increase in each County's real property tax rates that would have been required to generate this $250.4 million in lost tax revenue. As shown:

- Henrico County's real property tax rate would have likely had to increase from $0.870 per $100 of assessed value to $0.883 (a 1 percent increase),
- Loudoun County's real property tax rate would have likely had to increase from $1.085 per $100 of assessed value to $1.313 (a 21 percent increase), and
- Prince William County's would have likely had to increase from $1.125 per $100 of assessed value to $1.200 (a 7 percent increase).

Figure 5. Estimated County Real Property Tax Rates per $100 of Assessed Value with and without the Data Center Industry



Data Center Incentives in Virginia

Data centers in Virginia can qualify for two types of incentives: those offered by the state of Virginia and those offered by individual localities.

VIRGINIA'S STATE INCENTIVES

At the state level, two incentives are offered: a sales and use tax exemption and a single sales apportionment incentive. According to the Joint Legislative Audit and Review Commission (JLARC), the single sales apportionment incentive has not been used by any data centers as of fiscal year 2017 (the latest year that data is available), so we will not give more attention to it in this report.[51]

The sales and use tax exemption is available to data centers that make a minimum new capital investment of $150 million and that create a minimum of 50 new jobs in a Virginia locality. If the data center is located in an enterprise zone or in a locality with an unemployment rate at least 1.5 times the average statewide unemployment rate, the minimum new job requirement is reduced to 25. Each new job must pay at least 150 percent of the annual average wage in the locality where the data center is located. Tenants of colocation data centers that qualify for the incentive may also receive the sales and use tax exemption. According to the JLARC, as of fiscal year 2017, 24 data centers had qualified for the incentive, plus 135 colocation data center tenants.[52] According to JLARC's latest report, in fiscal year 2018, $86 million of sales and use tax was exempted under the incentive.[53]

JLARC's Evaluation and Findings

In June of 2019, Virginia's Joint Legislative Audit and Review Commission published an evaluation of the state's data center incentive using confidential tax information that is not publicly available.[54]

JLARC found that 90 percent of the data center investment made by the companies that received the sales and use tax exemption would not have occurred in the state of Virginia without the incentive. Instead, that 90 percent of data center investment would have occurred in states other than Virginia. So, the "cost" of the State data center incentive is only 10 percent of the amount of State sales tax revenue exempted. Using the confidential tax information, JLARC estimated the economic and government budgetary impact, not of the total data center industry in Virginia (as we have done in this report), but specifically, of Virginia's data center sales and use tax exemption.[55]

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[51] Joint Legislative Audit and Review Commission, *Data Center and Manufacturing Incentives Economic Development Incentives Evaluation Series*. June 17, 2019. (*JLARC, Data Center Evaluation*)
[52] Joint Legislative Audit and Review Commission, *Data Center and Manufacturing Incentives, Economic Development Incentives Evaluation Series*. June 17, 2019.
[53] Joint Legislative Audit and Review Commission, *Economic Development Incentives 2019, Spending and Performance*. December 16, 2019.
[54] Joint Legislative Audit and Review Commission, *Data Center and Manufacturing Incentives, Economic Development Incentives Evaluation Series*. June 17, 2019.
[55] Appendix N: Results of economic and revenue impact analyses.

Table 13 shows the text of Appendix N from the JLARC report with JLARC's calculations of the amount of State tax revenue exempted by the Virginia incentive; the amount of additional State tax revenue that was generated by the investment of the data centers that received the tax incentive; the net impact of the incentive on the State budget (additional tax received minus tax revenue exempted); net new jobs added, net additional state gross domestic product (GDP) generated, and net new worker pay generated throughout the statewide economy as a result of the investment by data centers that received the incentive. Table 13 shows data for the fiscal years 2013 through 2017. This is the most recent data available that covers the years when the current version of Virginia's data center incentive has been implemented. The General Assembly made significant revisions to the data center incentive in 2012.

Table 13. Economic and Tax Impacts of Virginia's Sales and Use Tax Exemption for Data Centers[56]

With Data Center Incentive	FY2013	FY2014	FY2015	FY2016	FY2017
State Tax Revenue Exempted	($81,298,000)	($80,131,000)	($93,249,000)	($54,757,000)	($54,516,000)
Additional State Tax Revenue	$44,548,000	$49,705,000	$64,494,000	$54,742,000	$59,171,000
Net State Budgetary Impact	($36,751,000)	($30,426,000)	($28,755,000)	($15,000)	$4,655,000*
State Revenue Recovered per $1 of State Revenue Exempted	$0.55	$0.62	$0.69	$1.00	$1.09
Net Additional Jobs	11,631	12,168	14,138	9,968	10,324
Net Additional State GDP	$1,594,238,000	$1,838,394,000	$2,268,541,000	$1,862,303,000	$2,028,606,000
Net Additional Worker Pay	$852,123,000	$987,672,000	$1,238,666,000	$1,022,226,000	$1,126,545,000

* In 2017, the data center tax incentive generated more State tax revenue than it exempted.

[56] Data Source: *Appendix N: Results of Economic and Revenue Impact Analyses*.

The appendix to the JLARC report shows that

- In 2017, the State took in $1.09 in state tax revenue from data center related activity for every $1 of potential state tax revenue that was exempted from qualifying data centers.
- In 2016, the data center incentive was revenue neutral – it generated one dollar in additional state tax revenue for every dollar of potential state tax revenue that it exempted.
- In every year since the data center incentive was modified in 2012, the State recovered the majority of the state tax revenue that was exempted from qualifying data centers.
- From 2013 through 2017, on average the State recovered 75 cents in state tax revenue for every dollar of potential tax revenue exempted from qualifying data centers.[57]

Virginia's Incentive is One of the Most Restrictive

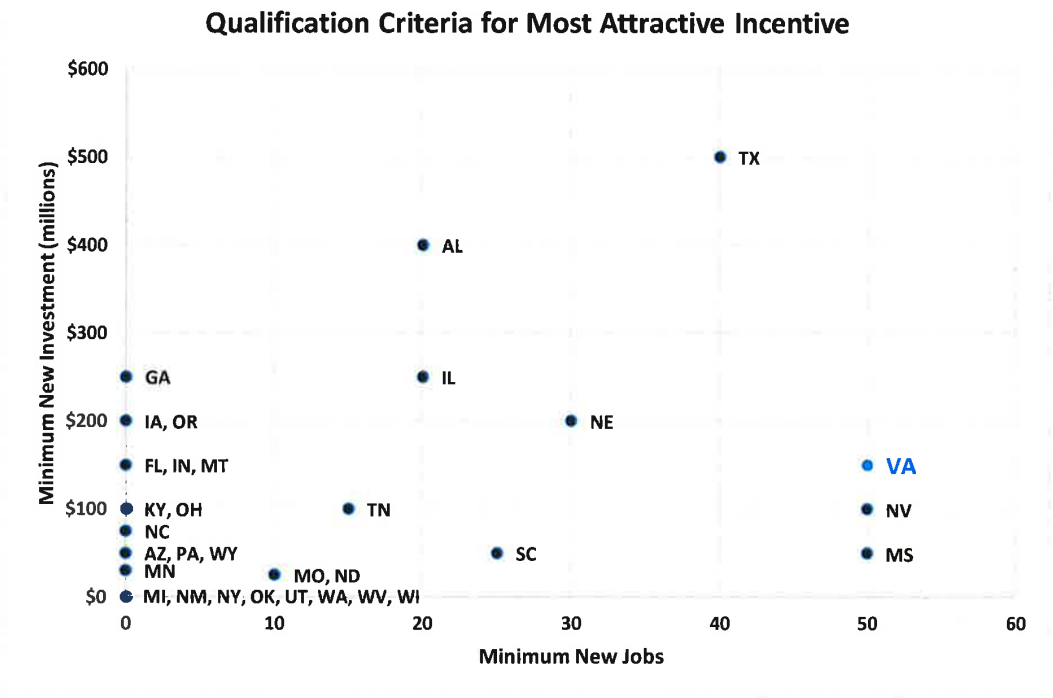
Virginia's data center incentive is structured so that it is only available to data centers that bring a certain minimum number of jobs and a minimum amount of investment to the state. In order to qualify, a data center must invest at least $150 million and add 50 new jobs to the local economy paying 50 percent more than the average annual wage in the locality (only 25 new jobs are required in unemployment distressed localities). These restrictions incentivize data center companies to make sizable investments in property and employment in the state.

Virginia's data center incentive is very stringent in terms of the number of new jobs required to qualify for it. Of the 31 states that actively offer data center incentives, only 11 require a minimum number of new jobs to qualify for an incentive, and only Virginia, Mississippi, and Nevada require the creation of 50 or more new jobs. In terms of the minimum amount of investment required to qualify for an incentive, Virginia's incentive is more restrictive than most other states. Only seven states (Alabama, Georgia, Illinois, Iowa, Nebraska, Oregon, and Texas) require a higher amount of investment in order to receive the state's most attractive incentive (and Alabama, Georgia, Iowa, Nebraska, and Texas all have graduated incentive criteria, so that lesser investments may still qualify for incentives). At the same time, 16 states offer their most attractive incentive to data center investments that are half as large as the amount that Virginia requires to qualify for its incentive.

[57] The JLARC report states that the data center incentive recovered 72 cents in state tax revenue for every dollar of potential tax revenue exempted from qualifying data centers. That conclusion is based on including the years 2010 through 2012, prior to the significant change made to the incentive in 2012. The 75-cent estimate more accurately reflects current state policy.

Figure 6 shows how the investment and job creation criteria in different states compare. The closer a state is to the lower-left corner of the graph, the less restrictive are the criteria to qualify for the state's most attractive incentive.

Figure 6. Minimum Investment and Job Creation Criteria for State Data Center Incentives[58]



JLARC's Primary Recommendation

In its evaluation, JLARC made some administrative and exploratory recommendations regarding the State's data center incentive. Its primary recommendation was for the General Assembly to consider "reduc[ing] or remov[ing] the minimum job creation requirement of the sales and use tax exemption for data centers locating in a distressed area or an enterprise zone."[59] JLARC suggested that a lower job creation threshold could encourage more data center growth in rural areas, based on its discussions with data center industry representatives.

Because of reduced availability and rising prices of land in Northern Virginia, data centers are likely to seek lower cost locations elsewhere in Virginia or outside of the state. Virginia has the opportunity to

[58] A list and brief description of state incentives is located in the separate accompanying Appendix.
[59] Joint Legislative Audit and Review Commission, *Data Center and Manufacturing Incentives, Economic Development Incentives Evaluation Series*. June 17, 2019.

continue to attract data centers to lower cost locations within the state, if the incentive requirements stay competitive. However, the 50-job requirement is hard to meet for data centers that are not larger than $300 million in capital investment. JLARC found that "one job is generally associated with $6.3 million in capital investment. Thus, a $150 million investment would be expected to create 24 jobs, on average."[60] As shown in Figure 9, Virginia, Mississippi, and Nevada are the only states that have a 50-job requirement to receive the most attractive incentive.

Areas of Virginia that are relatively more distressed could benefit significantly from data centers which are important sources of tax revenue, but which do not require substantial, costly local government services. However, according to JLARC, generally, distressed regions do not already have the skilled workforce in place that is necessary for data center operation, and it is often difficult to relocate workers from other locations. According to JLARC, "Savings from the exemption can provide resources to address these challenges."[61]

JLARC concluded that "The best approach at this time may be to reduce or remove the minimum job creation threshold in distressed areas and enterprise zones ... to encourage data center growth in these areas."[62]

Incentives have been Instrumental in the Development of Virginia's High-Tech Infrastructure

The way that the high-tech industry has developed in Virginia is instructive as to the value of the data center incentive. The earliest data centers began to cluster around Ashburn, Virginia at the dawn of the internet because that was one of the four original network access points serving the entire country. In 2010, Microsoft began building its data center in Mecklenburg County after Virginia had enacted its initial data center incentive bill. However, the growing industry did not begin to boom until after the General Assembly strengthened and expanded Virginia's data center tax incentive in 2012. The fiber installed to support the large data center investments in Northern Virginia and Southern Virginia allowed for a dramatic expansion of the industry in Virginia. As a result, Northern Virginia overtook the New York City area in 2015 as the world's largest data center market.

This expansion provided the impetus for Microsoft and Facebook to invest in bringing the MAREA subsea cable to Virginia Beach, instead of only relying on the transatlantic cables that land in the New York City area. Simultaneously, Telxius invested in the BRUSA cable connecting Virginia Beach to Puerto Rico and Brazil. The cable landing station in Virginia Beach has attracted the Globalinx, NextVN, and PointOne data centers to Virginia Beach. Virginia is recognized worldwide for its high-tech physical

[60] Joint Legislative Audit and Review Commission, *Data Center and Manufacturing Incentives, Economic Development Incentives Evaluation Series*. June 17, 2019.
[61] Joint Legislative Audit and Review Commission, *Data Center and Manufacturing Incentives, Economic Development Incentives Evaluation Series*. June 17, 2019.
[62] Joint Legislative Audit and Review Commission, *Data Center and Manufacturing Incentives, Economic Development Incentives Evaluation Series*. June 17, 2019.

infrastructure (conventional and renewable electric power facilities, terrestrial and subsea fiber networks, and data centers) as well as for its high-tech workforce.

The DP Facilities data center that opened in Wise County in 2017 takes advantage of the MidAtlantic Broadband Communities Corporation fiber connections to the MAREA subsea cable. The data centers in Northern Virginia and the cable landing station in Virginia Beach attracted Facebook to invest in its large data center in Henrico County, midway between the two locations. Additionally, QTS has connected its large data center and network access point in Henrico County to the subsea cables in Virginia Beach, offering very low latency connections to Europe and Brazil. Google is in the process of bringing its DUNANT cable from northern Europe to Virginia Beach, and SAEx International has planned a global cable system that will eventually connect Virginia Beach to Brazil, South Africa, India, and Singapore. This system will provide a digital global superhighway, providing a unique four-continent link from Asia to the Americas through Africa and creating a secure new submarine link that is able to avoid all the common choke and risk points, such as the current network route through the Mediterranean and Red Seas and the routes that are exposed to the seismic risks that exist in the Pacific Ring of Fire.

Data centers also are important for attracting other businesses to Virginia. For example, biotech firms are extremely dependent on the storage and computing capacity of data centers for healthcare innovations. This summer, after an extensive search, the biotech firm, Aperiomics chose Loudoun County for its permanent corporate headquarters. Aperiomics is the only firm able to identify every known bacterium, virus, fungus, and parasite. The company has created a new gold standard in identifying the root cause of infectious diseases, allowing doctors to prescribe precise treatments for specific infections. Aperiomics specifically identified the nearby access to data centers as one of the reasons that it chose Loudoun County. "With its growing reputation as a major technology hub, access to major data centers that allow us to maximize our Artificial Intelligence and genomic research and quick access to major healthcare hubs across the East Coast, we cannot imagine a better place to call home."[63]

The Virginia data center tax incentive sends a clear signal to potential investors worldwide that the business climate in Virginia is friendly to the high-tech industry. Beyond reputation, the incentive supports the investment in data centers, in conventional and renewable energy, in a robust fiber network, and in a high-tech workforce.

The Incentive Helps to Attract Some Data Centers that Do Not Qualify for the Incentive

Data centers tend to cluster, with smaller data centers often locating adjacent to larger data centers. Therefore, one data center that is attracted by the incentive can attract other data centers to take advantage of the then existing local fiber and power infrastructure.[64] Some of these follow-on data centers will be smaller than the larger data center projects that qualified for the tax incentive and may,

[63] https://biz.loudoun.gov/2019/05/30/aperiomics-headquarters/
[64] https://www.datacenterknowledge.com/industry-perspectives/finding-strength-numbers-data-center-clustering-effect

themselves, not initially achieve the investment and job creation thresholds required to receive tax benefit from the state.

Because large data centers that qualify for Virginia's incentive help provide the infrastructure and technology supply chain to attract smaller data centers that do not initially qualify for the incentive, the incentive yields more data center investment than is measured by just counting the data centers that qualify for the incentive. Virginia's data center tax incentive plays an important role in attracting new data centers to the state and in keeping them from moving to other states.

LOCAL INCENTIVES

Spurred by data center development in Northern Virginia, the growing importance of Virginia Beach as a landing site for subsea cables that provide high-speed connectivity between Virginia and the rest of the world, and Mid-Atlantic Broadband Communities Corporation's pioneering work in providing high-speed terrestrial connectivity in the southern half of Virginia, the data center industry is now spilling out from Northern Virginia and spreading throughout the state. In no small part because of the exceptionally high benefit to cost ratio that data centers provide to localities, many communities are working to take advantage of this trend by making themselves more attractive to the data center industry.

As discussed elsewhere in this report, data centers are a very capital-intensive industry. As a result, relative to less capital-intensive industries they are disproportionately and adversely impacted by taxes on expensive and short-lived capital equipment such as servers and other computer equipment. To address this disparity and provide a more welcoming business climate for data center development, several Virginia localities have recently lowered the business personal property tax rates that they charge to data centers.

A listing of Virginia localities creating special property tax rates for data center equipment is provided in Table 14. As this list shows, all of these communities are located in the corridor between the Richmond metropolitan statistical area and Northern Virginia, in proximity to the high-speed subsea cable landings in Virginia Beach, or, in the case of Danville, within the service area of the Mid-Atlantic Broadband Communities Corporation.

Table 14. Localities with Reduced Property Tax Rates for Data Centers

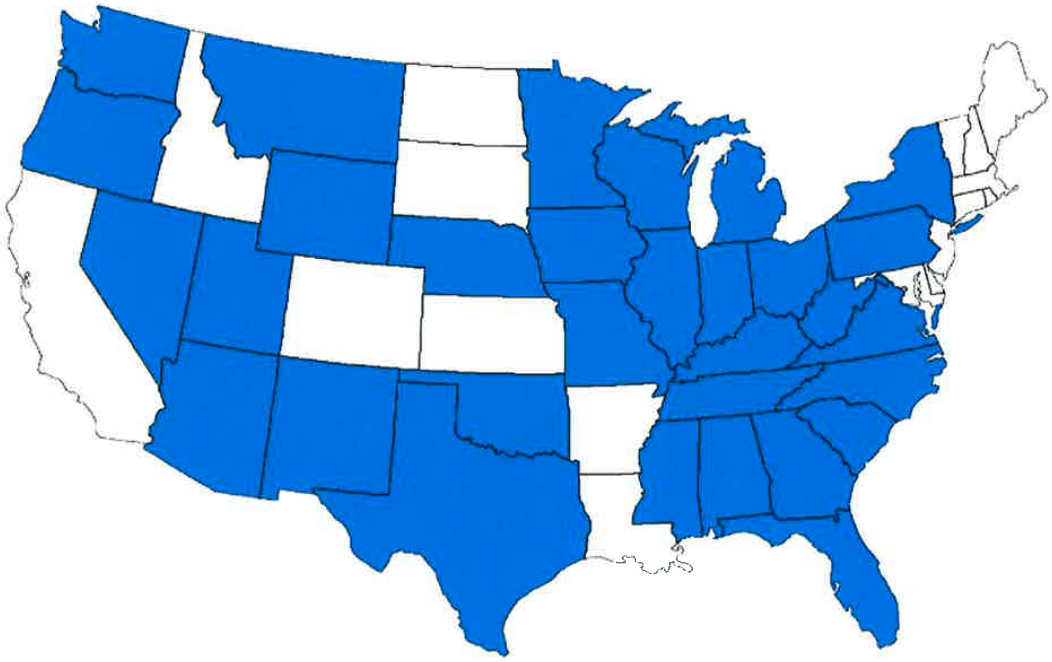
Locality	Nominal Business Property Tax Rate (per $100 assessed value)[65]	Special Property Tax Rate for Data Center Equipment (per $100 assessed value)
Caroline County	$3.80	$1.25[66]
Chesapeake	$4.08	$0.48[67]
Chesterfield County	$3.60	$0.24[68]
Danville	$3.50	$0.25[69]
Fredericksburg	$3.40	$1.25[70]
Goochland County	$3.95	$0.40[71]
Henrico County	$3.50	$0.40[72]
Prince William County	$3.70	$1.25[73]
Spotsylvania County	$5.95	$1.25[74]
Stafford County	$5.49	$1.25[75]
Virginia Beach	$4.00	$0.40[76]

[65] Does not include assessment ratios, which reduces the effective tax rate over time.
[66] Caroline County Economic Development. "Data Center Site".
[67] "Chesapeake City Council Makes Strategic Move to Attract Business in Data Center Sector". CoVABiz, April 2018 and Chesapeake Local Tax Rates.
[68] "Chesterfield County Cuts Data Center Tax Rate to Lowest in Virginia". Chesterfield Business News, April 2019 and Chesterfield County Business Tax Rates.
[69] John Crane. "Danville council OKs low rate for data centers", GoDanRiver, October 2018.
[70] Fredericksburg News. "Fredericksburg City Council Sets Highly Competitive Tax Rate for Data Centers," April 2019.
[71] Goochland County Fiscal Year 2020 Adopted Budget.
[72] Henrico County Fiscal 2018-2019 Approved Budget.
[73] Prince William County Tax Rates.
[74] Spotsylvania County FY 2020 Adopted Budget.
[75] Stafford County Tax Rates.
[76] Virginia Beach Tax Rates.

National Context for Virginia Incentives

Virginia is one of 31 states that actively offer incentives to attract data centers to locate in their states. Figure 7 highlights the states with active data center incentives.[77]

Figure 7. States with Active Data Center Incentives



In June of 2019, Illinois became the latest state to add a new data center incentive.[78] Although the Chicago area is one of the largest data center markets in the United States, it was not keeping pace with the growth of data centers in the markets of Northern Virginia, Dallas, and Phoenix – all states that provide incentives to attract data center investment. Additionally, Illinois was failing to attract data centers to the more rural parts of the state, while several large data centers had located across the border in rural Iowa. The neighboring state of Indiana also strengthened its incentives in June 2019 by

[77] North Dakota has an incentive that was capped and is no longer available to new data centers, so we do not count it as an active incentive. In addition to the 31 states that have active specific incentives for data centers, four of the other states have tax policies that are beneficial to data centers. Alaska and New Hampshire have no statewide sales tax; Delaware has no state property or sales tax; and Kansas has no state property tax on equipment.

[78] Ally Marotti. "Data center boosters hope new tax incentives 'stop the bleeding,' keep tech sites in Illinois," *Chicago Tribune*, June 2019.

adding a sales and use tax exemption for data centers to its existing targeted property tax exemption.[79] Developers are hoping to attract data centers to the Indiana suburbs of Chicago.

The competition among states for data centers is keen, and data centers pay close attention to the business climate in various states when making location decisions. States with existing incentives revise and extend them from time to time to make them more attractive. In May of 2018, Georgia expanded its data center tax incentive to include colocation data centers. Days after the governor of Georgia signed the bill into law, the colocation provider Switch announced plans to begin construction on a one million square foot data center campus in Atlanta.[80] Earlier this year, bills were introduced in the Pennsylvania state legislature to expand data center incentives that were enacted in 2016.[81] After Illinois enacted a data center incentive, Indiana revised its data center incentive to lengthen the amount of time that large data centers could receive that state's incentive.[82]

WASHINGTON STATE HAS PROVEN THE EFFECTIVENESS OF INCENTIVES

Washington State is home to the corporate headquarters of Microsoft and Amazon. In 2007, Washington's Attorney General ruled the state's data center incentives invalid. Microsoft and Yahoo immediately halted construction on data center facilities in rural Quincy, Washington, and Microsoft subsequently chose to move its Windows Azure cloud computing service to Texas. Facebook and Amazon also cited state and local taxes as an important consideration in their decisions to construct new data center facilities in Oregon.

Washington's data center incentives were legislatively re-enacted in 2010, sparking a construction boom and up to $2 billion in new private investment in the state. But, in 2011 the incentives lapsed, which once again halted data center growth in Washington and was associated with $1 billion in new data center investment by Adobe and Apple in Oregon. In 2012, Washington again re-enacted their data center incentives, only to fail to reauthorize them in 2014. At least one major software company cited that lack of reauthorization as a motivating factor in its decision to build a new $1.1 billion data center in Iowa. Washington then re-enacted its data center incentives yet again in July 2015. The current incentive is only available in rural counties. This restriction in Washington has led to a boom in the colocation data center market in the suburbs of Portland, Oregon, just across the border from Washington State.[83] The state is debating revising the incentive again to remove the restriction to rural counties.[84]

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[79] Dan Carden. "Tax incentives for Hammond data center advance to governor for final approval," *The Times*, April 2019.
[80] Switch. "Georgia Governor Nathan Deal Signs "Switch Bill" Data Center Tax Exemption Legislation."
[81] General Assembly of Pennsylvania, House Bill 1088, Session of 2018.
[82] Alex Brown. "Governor Signs Data Center Incentive Bill," *Inside Indiana Business*, June 2019.
[83] Washington State Department of Commerce, *State of the Data Center Industry An Analysis of Washington's Competitiveness In This Fast-Growing High-Tech Field*, January 2018.
[84] The Herald Editorial Board. "Editorial: Tax break could bring more data centers to state," *HeraldNet*, March 2018.

Conclusion

Life is increasingly digitized, and our digitized lives are stored, secured, processed, enhanced, and distributed by data centers. Our finances, communications, health care, recreation, entertainment, education, transportation, work, and social lives are often and increasingly online. Data centers are more than just the redundant warehouses for our digital lives. They are also the generators of much of the interactive digital content that we use. The personalized shopping recommendations; the on-the-fly driving directions; the online assistance selecting a restaurant, hotel, plane flight; the digital grocery coupons; the machine responses to banking and billing inquiries, etc. are all provided by data centers.

Because data centers use large amounts of costly electricity and water, they have emerged as leading innovators at the forefront of increasing operational efficiency in the use of energy and water. Among other innovations, data centers have used digitization, advanced sensors, and machine learning (within data centers) to dramatically reduce energy and water consumption. For example, Google has been able to reduce the amount of energy used for cooling in its data centers by up to 40 percent, reducing overall energy usage in its data centers by 15 percent on top of previous efficiency enhancements.3 Data center companies have also made large commitments to the purchase of energy from renewable sources here in Virginia and nationwide. For utility companies to move to different and initially costlier sources of renewable power, they need this kind of commitment to provide a stable demand to ensure that the large upfront investments that are required are financially sustainable.

Northern Virginia is the largest data center market in the world, but the data center industry has an important footprint in every part of the Commonwealth of Virginia. Central Virginia and Hampton Roads each account for almost ten percent of overall industry employment in the state. Data center industry pay has increased twice as fast as the statewide average since 2001.

We estimate that in 2018 the data center industry in Virginia directly provided approximately:

- 14,644 full-time-equivalent jobs with an average annual pay of $126,000,
- $1.9 billion in associated pay and benefits, and
- $4.5 billion in economic output.

Taking into account the economic ripple effects that direct investment generated, we estimate that the total impact on Virginia from the data center industry in 2018 was approximately:

- 45,290 full-time-equivalent jobs,
- $3.5 billion in associated pay and benefits, and
- $10.1 billion in economic output.

Data centers pay millions of dollars in state and local taxes in Virginia, even though Virginia has a sales and use tax exemption on some equipment for data centers that are large enough to qualify for the exemption. All data centers pay state employer withholding taxes and corporate income tax. At the local level, they pay real estate taxes, tangible personal property taxes, business license taxes, and industrial

utilities taxes. Additionally, many data centers still must pay state sales and use taxes on their purchases of data center equipment because they are not large enough to qualify for the Virginia data center incentive. In addition to the taxes paid directly by data centers, local governments and the Commonwealth of Virginia collect tax revenue from the secondary indirect and induced economic activity that data centers generate. We estimate that in 2018, data centers were directly and indirectly responsible for generating $600.1 million in state and local tax revenue in Virginia.

At the local level data centers provide far more in county or city tax revenue than they and their employees demand in local government services. For example, we estimate that for every dollar in county expenditures that the data center industry caused in 2018, it generated:

- $8.60 in local tax revenue in Henrico County, and property taxes there would have had to rise by 1 percent without the data center induced tax revenue.
- $15.10 in local tax revenue in Loudoun County, and property taxes there would have had to rise by 21 percent without the data center induced tax revenue.
- $17.80 in tax revenue in Prince William County, and property taxes there would have had to rise by 7 percent without the data center induced tax revenue.

In June of 2019, Virginia's Joint Legislative Audit and Review Commission (JLARC) published an evaluation of the state's data center sales and use tax incentive. JLARC found that 90 percent of the data center investment made by the companies that received the sales and use tax exemption would not have occurred in the state of Virginia without the incentive. Instead, that data center investment would have occurred in other states. So, the "cost" of the State data center incentive is only 10 percent of the amount of State sales tax revenue exempted. In fact, in 2017, the data center tax incentive generated $1.09 of State tax revenue for every dollar that it exempted; and in 2016, the incentive was revenue neutral. Since 2013, after the General Assembly significantly revised the Virginia data center incentive, the State has recovered 75 cents of every dollar of potential tax revenue that it exempted. In the process it created thousands of Virginia jobs with billions of dollars in pay and benefits and billions of dollars in economic activity throughout the state.

Virginia is one of 31 states that actively offer incentives to attract data centers to locate in their states. Several states are in the process of revising their incentives to remain competitive. In May of 2018, Georgia expanded its data center tax incentive to include colocation data centers. In 2019, bills were introduced in Idaho to enact an incentive for the first time, and the Pennsylvania state legislature to expand data center incentives that were enacted in 2016. After Illinois enacted a data center incentive in 2019, Indiana revised its data center incentive to lengthen the amount of time that large data centers could receive that state's incentive. Also in 2019, the State of Washington debated whether to continue restricting its incentive to rural counties, because of the loss of many colocation data centers to the Portland area just across the border with Oregon-Washington border.

Virginia's data center incentive is one of the most restrictive in the country. Of the 31 states that actively offer data center incentives, only 11 require a minimum number of new jobs to qualify for an incentive, and only Virginia, Mississippi, and Nevada require the creation of 50 or more new jobs. In its evaluation,

JLARC recommended "reduc[ing] or remov[ing] the minimum job creation requirement of the sales and use tax exemption for data centers locating in a distressed area or an enterprise zone." JLARC suggested that a lower job creation threshold could encourage more data center growth in rural areas. The 50-job requirement is hard to meet for data centers that are not larger than $300 million in capital investment. Virginia, Mississippi, and Nevada are the only states that have a 50-job requirement to receive each state's most attractive incentive. Areas of Virginia that are relatively more distressed could benefit significantly from data centers which are important sources of tax revenue, but which do not require substantial, costly local government services. However, according to JLARC, generally, distressed regions do not already have the skilled workforce in place that is necessary for data center operations, and it is often difficult to relocate workers from other locations.

Virginia's incentive is more restrictive than most other states in terms of minimum investment. Only seven states require a higher amount of investment in order to receive the state's most attractive incentive. At the same time, 16 states offer their most attractive incentive to data center investments that are half as large as the amount that Virginia requires to qualify for its incentive.

Virginia's data center incentive has been important in the spread of technology industries across the Commonwealth and in attracting smaller data centers that do not qualify for the incentive to invest in the state as well. Recently several localities have reduced their local property tax rates in order to attract data centers to support their economies.

THE IMPACT OF DATA CENTERS ON THE GEORGIA ECONOMY

Prepared for

DATA CENTER COALITION

METRO ATLANTA CHAMBER

TAG Technology Association of Georgia

DECEMBER 2021

MANGUM economics

About The Data Center Coalition

The Data Center Coalition (DCC) is the trade association that empowers the data center industry through education, public policy advocacy, and community engagement. The DCC represents and advances the interests of the data center industry by aggregating industry expertise and thought leadership, partnering with policymakers and other stakeholders, and supporting data center communities through active engagement. To learn more, go to https://www.datacentercoalition.org/.

About The Metro Atlanta Chamber

The Metro Atlanta Chamber (MAC) is an organization that is over 160 years old that today represents businesses, colleges and universities, and nonprofits across the 29-county region that makes up the nation's ninth-largest market. MAC works to position metro Atlanta as a top-tier global region by focusing on three key areas: economic development, public policy, and promotion. MAC's public policy efforts reflect the organization's commitment to protect Georgia's status as the number one state to do business. To learn more, go to https://www.metroatlantachamber.com/

About The Technology Association of Georgia

The Technology Association of Georgia's (TAG's) mission is to connect, promote, influence, and educate Georgia's technology ecosystem to advance the innovation economy. Through those four foundational pillars TAG serves the technology community, helping to support, grow and ignite tech leaders, companies, and the overall Georgia economy. TAG provides catalytic connections and bridges to growth opportunity for the technology community; advances policies, programs, and initiatives that grow business, our members, and Georgia's technology ecosystem; and energizes, promotes, and educates the tech stars of today and the tech leaders of the future. To learn more, go to https://www.tagonline.org/

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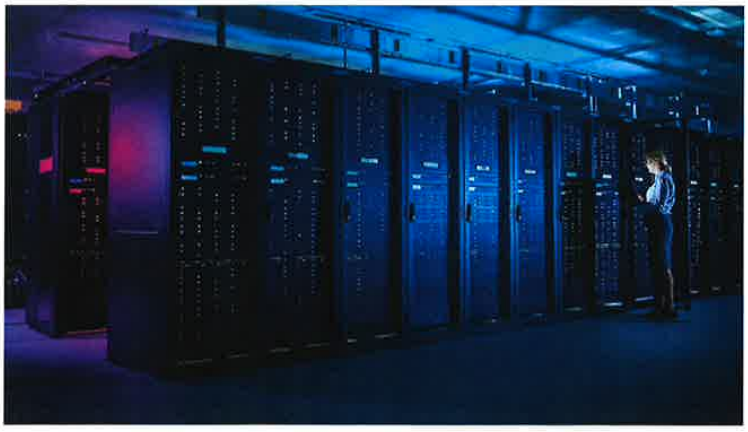

Executive Summary

Georgia has had a growing data center sector that was expected to continue to grow, partially driven by incentives that the state offers to encourage data center job growth and investment. Georgia has approximately 100 data centers in the state, with the majority located in the broader Atlanta metropolitan area of Fulton,[1] Cobb[2] and Gwinnett[3] counties. There is also significant data center investment in Bulloch, Carroll, Douglas, and Newton counties, with Douglas[4] and Newton[5] counties having large hyperscale data centers that account for over one billion dollars in investment each. It should be noted that almost all of the planned new projects that have been announced will be located in these less densely populated counties outside of the Atlanta metro area.

This report explores the economic impact of the construction and operation of data centers in Georgia and illustrates the economic impact that a single new hyperscale data center would create. It also puts into context Georgia's standing relative to other states with data center incentive programs. We estimate that there are about 100 data center facilities in Georgia, and we estimate that it would cost $35 billion (in 2021 dollars) to construct and commission to full operating status all of that data center space that is currently operating in the state.

Direct Economic Impact: We estimate that in the last year,[6] the construction and operation of data centers in Georgia directly provided approximately:

- **$1.4 billion in economic output from construction and operations combined, including:**
- 1,020 construction jobs,
- $70 million in associated construction pay and benefits,
- 3,480 full-time-equivalent onsite operations jobs inside data centers, and
- $276 million in associated data center operations pay and benefits.

Total Economic Impact: Taking into account the economic ripple effects that the direct investment generated, we estimate that the total impact on Georgia from data centers in the last year was approximately:

- **$5.3 billion in economic output, including:**
- 22,940 jobs throughout the Georgia economy,
- $1.5 billion in associated employee pay and benefits, and
- five additional jobs supported by the data center in other non-construction businesses for each operational job inside the data center.

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[1] Among many other companies, Equinix, Digital Realty, and QTS have data centers in Fulton County.
[2] Digital Realty and DataSite have data centers in Cobb County.
[3] QTS has a data center in Gwinnett County.
[4] Google's data center is located in Douglas County. Google is proud to call Georgia home to one of our data centers.
[5] Facebook's data center is located in Newton County. Andy Peters, "Facebook to expand Newton County data center, add 100 jobs," *The Atlanta Journal-Constitution*, September 17, 2020.
[6] The data used for the impact calculations in this report roughly span the period of July 2020 through June 2021.

State and Local Tax Revenue: We estimate that in the last year, the economic activity associated with the construction and ongoing operations of data centers in Georgia led to:

- $92.4 million in tax revenue collected by the State of Georgia in corporate and personal income tax, sales tax, gas and vehicle tax, and fees; and
- $101.5 million collected by local governments in real and personal property tax, sales tax, and fees, not counting sales taxes and franchise fees that data centers pay on electricity purchases.

Economic Impact If Georgia Can Attract One New Hyperscale Data Center: Construction and operation of a single new hyperscale data center would have a potential total economic impact of approximately:

- **$346 million in total economic output during the two-year construction period, including:**
- 1,200 construction jobs plus 850 non-construction jobs supported in the community during the construction phase, and
- $132 million in total pay and benefits.
- **$431 million annually in total economic output once the facility is fully operational, including:**
- 1,830 additional jobs supported once data center operations begin, and
- $112 million in pay and benefits.

Workforce Benefits of Data Centers: Georgia's data centers contribute to the development of a strong tech workforce across various industries with growing employment and wages. In fact, the combination of rapidly rising employment and rapidly rising wages make data centers one of Georgia's most high-performing lines of business and a valuable (and growing) contributor to a strong and robust state economy.

- From 2010 to 2020, the concentration of tech workers in Georgia grew from almost 20 percent below the national average to almost 40 percent above the national average.
- From 2010 to 2020, the gross income for an average private-sector data processing and hosting employee grew almost twice as fast as the average private-sector employee in Georgia.

Between 2010 and 2020 the average annual pay in the data center industry in Georgia increased twice as fast as the average private-sector employee in Georgia.

- **Data center industry wages in Georgia:** 64 percent increase ($78,500 to $128,700) vs. 35 percent average increase in private wages across all industries ($44,300 to $59,800).

Data Center Sales and Use Tax Incentive Programs: Data center tax incentives are an effective way to encourage data center investment and growth in a state, and they can accomplish that without negatively impacting state revenues. In fact, over half of U.S. states have sales and use tax exemptions for data centers. Virginia's Joint Legislative Audit and Review Commission found in a 2019 report that:

- Up to 90 percent of the data center investment in Virginia made by the companies that received the sales and use tax exemption would have occurred in other states except for the exemption.
- In 2017, the most recent year data was available, the data center tax incentive generated $1.09 of Virginia tax revenue for every dollar that it exempted (this is not including local tax revenue or other economic benefits).

Georgia's Incentive Programs: Georgia is one of many states that offer sales and use tax incentive programs to encourage data centers to locate or expand in the state. However, because of the short duration of the benefits, they are some of the least attractive programs in the country. Both of Georgia's programs sunset in seven years or less. Of the states with a sales and use tax exemption for data centers, a majority have a benefit period that is a minimum of 10 years, with the exemptions in eleven states having no sunset date.

- **Georgia High-Tech Business Incentive O.C.G.A. § 48-8-3(68) (program sunsets and benefit ends June 30, 2023).** This was a permanent incentive program until a sunset was enacted in March 2021. This incentive provides a full sales-and-use tax exemption on certain computer equipment purchased by high-tech companies that invest a minimum of $15 million in qualifying equipment.

- **Georgia Data Center Incentive O.C.G.A. § 48-8-3(68.1) (program sunsets and benefit ends December 31, 2028).** This incentive provides a sales and use tax exemption for data centers that make a minimum investment of $100 million to $250 million (investment threshold is dependent on the population of the county) and creates 20 new jobs within seven years of qualifying for the incentive.

Data centers, like most capital-intensive businesses, make long-term investment decisions where the financial conditions are most secure due to the long-term nature of their investment. Companies who build and operate data centers want to choose a location where they can confidently predict their tax liability years into the future, especially if they want to expand their presence over the long term.

It is important to note that under Georgia's incentive programs, the incentive benefit period coincides with the sunset, effectively ending the program when the sunset date is reached. Most other states with a data center sales and use tax exemption do not have the benefit period ending for companies at the same time as the program sunsets for new applicants. This means that a company locating a data center in Georgia today could only utilize the benefit for five years (assuming an 18-month construction window). In Georgia's neighboring state of Alabama, a company locating a new data center could utilize that state's benefit for up to 30 years.

Georgia's incentive programs provide less long-term certainty for data center operators than is offered across the country, including in states that recently adopted or extended their data center incentive. Twenty-six states have incentives that last for 10 years or more, with 11 states having incentives that are valid indefinitely. (select examples of data center sales and use tax exemptions across the country)

Southeast (Neighboring states):

- Alabama offers up to a 30-year sales and use tax exemption. (AL 40-9B-3)
- Mississippi's ten-year sales and use tax exemption has no program sunset. (MS 57-113-25)
- North Carolina's sales and use tax exemption has no program sunset. (NC 105-164.13)

- South Carolina's sales and use tax exemption sunsets for new applicants in 2031 with benefits ending in 2041. (SC 12-36-2120)
- Tennessee's sales and use tax exemption and reduced tax on electricity has no program sunset. (TN 67-6-206)
- Virginia's sales and use tax exemption sunsets at the end of 2035. (VA 58.1-609.3)

East:

- Connecticut offers up to a 30-year sales and use tax exemption with no program sunset. (CT Public Act 21-1, HB 6514)
- Maryland offers up to a 20-year sales and use tax incentive with no program sunset. (MD 11-239)
- Pennsylvania offers at least a 15-year sales and use tax exemption with no program sunset. (72 PS 9931-D)

Midwest:

- Illinois offers up to a 20-year sales and use tax exemption with a sunset for new agreements in 2029. (IL 605-1025a)
- Indiana offers up to a 50-year sales and use tax exemption with no program sunset. (IN 6-2.5-15)
- Iowa's sales and use tax incentive program has no program sunset. (IA 423.3)
- North Dakota's sales and use tax incentive has no program sunset. (NDCC 57-39.2-04.17)

West:

- Arizona offers a sales and use tax exemption with a 10 to 20-year benefit with a sunset for new applicants in 2033. The 20-year benefit is reserved for data centers that are considered a sustainable redevelopment project. (AZ 41-1519)
- Idaho's sales and use tax exemption has no program sunset. (63-3622V)
- Texas offers up to a 20-year sales and use tax exemption with no program sunset. (TX 151.3595)
- Utah's sales and use tax exemption has no program sunset. (UT 59-12-104)

Potential 10-year Horizon: We estimate that if the availability and competitiveness of Georgia's incentives are extended by at least 10 years, Georgia is likely to gain the following as new datacenter investment comes to Georgia instead of going to other states:

- **$3.1 billion in economic output, including:**
- 13,950 jobs, and
- $887 million in pay and benefits.

That is roughly the equivalent of attracting seven to eight new hyperscale data centers to the state over 10 years.

Georgia Has Had a Growing Data Center Market

Georgia has maintained a growing data center sector for the last several years, partially driven by the state's data center incentive programs. Within the state, there are:

- **Enterprise data centers, including large hyperscale data centers,** that are owned and operated by businesses for their own internal use, including companies who rely on tech and data processing for their business (e.g., finance, logistics, transportation, and tech companies). Some of these companies are headquartered in Georgia and have significant operations in the state.
- **Colocation data centers** that provide data center services to other companies as tenants or end users.

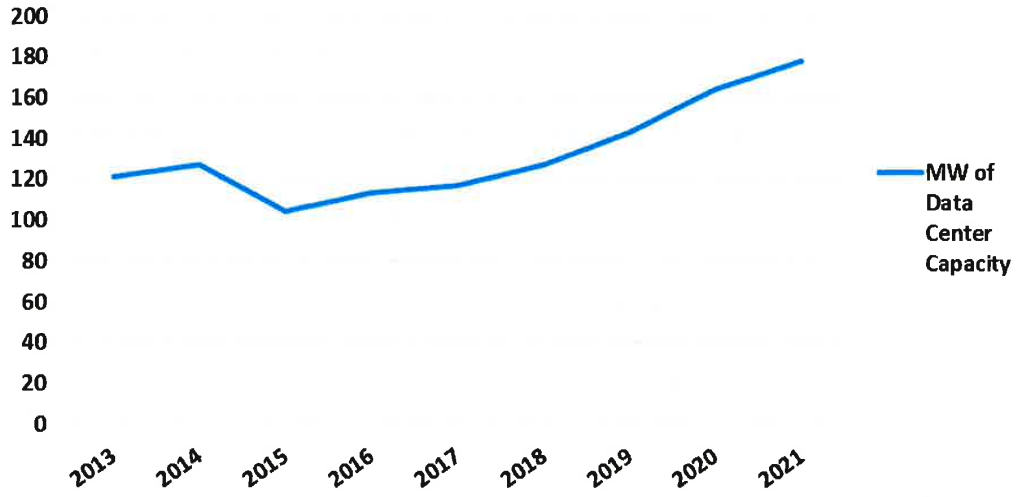
Georgia has approximately 100 data centers in the state. The number and magnitude of data centers in Georgia is an indicator that the state's data center incentives have helped to develop a pipeline of investment. A majority of data centers are located in the broader Atlanta metropolitan area, especially in Fulton,[7] Cobb,[8] and Gwinnett[9] counties, where the population density ranges between 2,000 to 2,200 people per square mile. There is also major data center investment in Douglas[10] and Newton[11] counties that have attracted large hyperscaledata centers that account for over one billion dollars in investment each. There is also data center investment in Bulloch and Carroll counties. The population density in those counties ranges from about 700 people persquare mile down to 100 people per square mile. Almost all of the planned projects that have been announced will be located in these less densely populated counties outside of Atlanta.

While information on enterprise data centers is generally kept confidential for security and other reasons, information on the amount of computing capacity in colocation data centers illustrates the growth in the overall data center sector in the state. According to CBRE, the commercial real estate services company, the colocation data center market in the Atlanta area has grown steadily by 47 percent since 2013, with almost all of that growth (85 percent of it) occurring since 2018 when the Georgia legislature enacted the Georgia Data Center incentive (O.C.G.A. § 48-8-3(68.1)).

Figure 1 shows the increase in colocation data center capacity (measured in megawatts of IT capacity) in the Atlanta area since 2013.

[7] Among many other companies, Equinix, Digital Realty, and QTS have data centers in Fulton County.
[8] Digital Realty and DataSite have data centers in Cobb County.
[9] QTS has a data center in Gwinnett County.
[10] Google's data center is located in Douglas County. Google is proud to call Georgia home to one of our data centers.
[11] Facebook's data center is located in Newton County. Andy Peters, "Facebook to expand Newton County data center, add 100 jobs," *The Atlanta Journal-Constitution*, September 17, 2020.

Figure 1. Growth in the Size of the Colocation Data Center Market in the Atlanta Area – 2013 to 2021[12]



ADDITIONAL NEAR-TERM DATA CENTER DEVELOPMENT

According to CBRE, in addition to the 178 MW of colocation data center capacity already in Atlanta, 23.5 MW of colocation data center capacity were under construction as of the first half of 2021. Some examples of projects (both colocation and enterprise data centers) that were announced in 2020 or early 2021 include:

2020 announcements:

- Stack Infrastructure's plan to double the size of its data center in Fulton County,[13]
- Switch's construction of a one million-plus square foot data center campus in Douglas County,[14]
- Facebook's expansion of its Newton County data center by 1.5 million square feet,[15] and
- Oceanic Data Centers' plans for a one million square foot data center in Fayette County.[16]

2021 announcements:

- Quality Technology Services' (QTS) construction of a 1.1 million square foot data center as part of a mixed-use development on 36 acres of land in Fulton County (May 2021 announcement),[17] and
- Microsoft's commitment to building its East US 3 Azure data centers in Douglas and Fulton counties (February 2021 announcement).[18]

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[12] Data Source: CBRE semiannual data center market reports 2014-2021 covering the years 2013-2021.
[13] *Stack Infrastructure Further Expands Atlanta Presence with Land Purchase*.
[14] *Switch Signs Anchor Tenant at The Keep Campus in Atlanta and Breaks Ground on Next Two Buildings*. The Keep Campus is already partially operational.
[15] *Facebook Expands the Newton Data Center*.
[16] Ben Nelms, "Developer expects to start in late 2021 on Fayetteville data center," *The Citizen*, October 28, 2020.
[17] *Project Granite* application.
[18] *Microsoft will establish its next U.S. datacenter region in Georgia's Fulton and Douglas Counties*.

Previous industry expectations for growth in the Georgia data center market were based on the expectation that Georgia's data center incentive programs would remain competitive. The enactment of a 2023 sunset earlier this year on the High Tech Program and the limited duration of the Data Center Incentive (scheduled to sunset in 2028) interject significant uncertainty into Georgia's business climate and raise questions around whether growth in the state's data center investment pipeline will continue.

THE IMPACT OF DATA CENTERS ON THE GEORGIA ECONOMY

The large pipeline of data center construction projects listed above means that Georgia construction workers have a long-term pipeline of local projects where they are better able to work locally, rather than pursue projects in other states. The construction and ongoing operation of data centers in Georgia have large impacts on the state's economy. These economic impacts are driven by:

Direct Impacts:

- The spending in Georgia on the construction of data centers
- The spending on goods and services in Georgia that data centers make during the ongoing operation of data centers

Indirect Impacts:

- The spending on goods and services in Georgia made by data center vendors
- The spending by Georgians employed in building and operating data centers

Direct Economic Impact: We estimate that in the last year[19] the construction and operation of data centers in Georgia directly provided approximately:

- **$1.4 billion in economic output from construction and operations combined, including:**
- 1,020 construction jobs,
- $70 million in associated construction pay and benefits,
- 3,480 full-time-equivalent onsite operations jobs inside data centers, and
- $276 million in associated data center operations pay and benefits.

Total Economic Impact: Taking into account the indirect economic ripple effects that the direct investment generated, we estimate that the total impact on Georgia from data centers in the last year was approximately:

- **$5.3 billion in economic output, including:**
- 22,940 jobs
- $1.5 billion in associated employee pay and benefits
- five additional jobs supported by the data center in other non-construction businesses for each operational job inside the data center.

State and Local Tax Revenue: We estimate that in the last year, the indirect economic activity associated with data centers in Georgia led to:

[19] The data used for the impact calculations in this report roughly span the period of July 2020 through June 2021.

- $92.4 million in tax revenue collected by the State of Georgia, and
- $101.5 million collected by local governments, not counting sales taxes and franchise fees that data centers pay on electricity purchases.

Table 1 provides a summary of the total construction and operation impact of data centers on the state of Georgia over the last year.

Table 1. Summary of One-Year Economic Impact of Data Centers in Georgia (2021 dollars)

1st Round Direct Effects	Jobs	Pay & Benefits	Economic Output
Data Center Construction	1,020	$69,600,000	$164,000,000
Data Center Operation	3,480	$275,800,000	$1,198,200,000
2nd Round Indirect Effects			
Data Center Construction Supported	720	$42,000,000	$129,700,000
Data Center Operation Supported	17,720	$1,068,900,000	$3,782,700,000
Total Impact			
Construction Subtotal	**1,740**	**$111,600,000**	**$293,700,000**
Operation Subtotal	**21,200**	**$1,344,700,000**	**$4,980,900,000**
Total Economic Impact in Georgia	**22,940**	**$1,456,300,000**	**$5,284,600,000**

THE IMPACT OF A SINGLE NEW HYPERSCALE DATA CENTER

To help make the overall statewide estimates of the impact of the entire data center sector more concrete, we can illustrate the economic and fiscal impact potential if just one new $750 million hyperscale data center were to locate in Georgia. It is important to note that there is significant variability among hyperscale data centers in terms of size, design, capacity, and other characteristics. Our assumptions and calculations are based on an aggregation of information associated with several actual hyperscale data center projects across the country and information provided by industry sources.

Assumptions used to estimate the impact of a $750 million hyperscale data center:

- Construction: $240 million would be spent for construction (including the employment of 1,200 construction workers) in total over the 18 to 24 months that a data center of this scale would typically take for construction.
- Construction: $460 million would be spent on computer equipment that is almost always sourced outside of the region of interest and does not contribute to local economic activity.
- Construction: $50 million would be paid for the purchase of cooling and electrical equipment and other fixtures.
- Operation: eventually employ 300 direct employees and contractors that provide services such as security and maintenance.

Construction

Direct Economic Impact (24-month construction period):

- **$193 million in economic output in the Georgia economy, including:**
- 1,200 total construction jobs, and
- $82 million in associated pay and benefits for construction workers.

Total Economic Impact (24-month construction period):

Accounting for all of the additional effects that the project would cause as the new investment ripples through the Georgia economy, construction of such a new hyperscale data center would have a potential total economic impact over the two-year construction period of approximately:

- **$346 million in total economic output, including:**
- 2,050 jobs supported, and
- $132 million in total pay and benefits.

Operation

Direct Economic Impact (annually, once fully built out/operational)

- **$103 million in economic output in the Georgia economy once the data center is fully operational, including:**
- 300 new operational jobs, and
- $24 million in associated pay and benefits for operating workers.

Total Economic Impact (annually, once fully built out/operational):

Once such a facility is fully operational and after accounting for all of the direct and indirect effects that the project would cause in the Georgia economy, the potential total economic impact would be approximately:

- **$431 million annually in total economic output, including:**
- 1,830 jobs supported once data center operations begin, and
- $112 million in pay and benefits.

Data Centers Benefit the Broader Economy in Georgia

Data centers have generated business for Georgia companies that are critical pieces of the data center supply chain that in turn generate economic activity and growth for other businesses in Georgia. Table 2 shows a selection of different Georgia businesses that are part of the second ripple effect of economic activity related to spending by data centers.

Table 2. Select Georgia-Headquartered Businesses Serving Georgia Data Centers[20]

Company	HQ City	Line of Business
AC & DC Power Technologies	College Park	Critical power maintenance services and distributor of server racks and cabinets
Alexander Electric Company	Columbus	National electrical contractor
Allison-Smith Company	Smyrna	National electrical engineering contractor
Capital City Electrical Services	Norcross	Regional electrical contractor
HEATSINC	East Dublin	International builder of power infrastructure
Holder Construction	Atlanta	Large, global builder of data centers
Inglett & Stubbs	Mableton	National electrical contractor
Jerry L. Johnson & Associates	Morrow	General contractor for data center construction and renovation
Optima Electronic Packaging Systems	Lawrenceville	Custom manufacturer of server enclosures
Southland Electrical Contractors	Madison	Regional electrical contractor

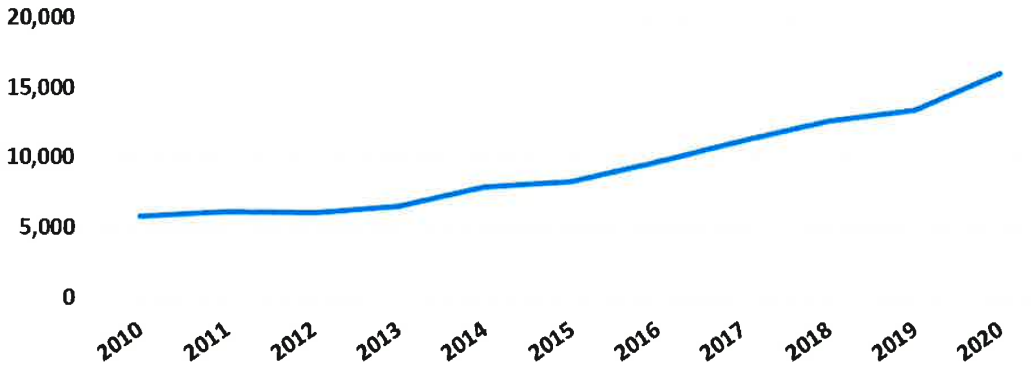
[20] None of the companies named here were consulted for this report nor did they request to be included. They are included based only on our own independent research. Again, this list is by no means comprehensive. It is for illustration only.

DATA CENTERS INCREASE THE TECH LABOR POOL NEEDED BY MANY INDUSTRIES

Data Center Employment

At the same time that data center investment in Georgia has been increasing, employment in high-tech sectors has increased. Private sector statewide data processing and hosting[21] employment has escalated rapidly from 5,800 in 2010 to 16,000 jobs in 2020 (Figure 2), and from 2010 to 2020, the concentration of tech workers in Georgia grew from almost 20 percent below the national average to almost 40 percent above the national average.[22]

Figure 2. Georgia's Data Processing and Hosting Employment – 2010 to 2020[23]



Georgia has developed a stronger than average tech labor market that is important for attracting businesses in industries ranging from advanced manufacturing to finance. The existence of a vibrant data center market helps to attract talent that supports all of these vital industries. Research has shown that data centers share the pool for high-tech labor with industries such as architecture, engineering, computer system design, software, telecommunications, scientific research & development, and technical consulting.[24]

Data Center Wages

The combination of rapidly rising employment and rapidly rising wages make data centers one of Georgia's most high-performing lines of business and a valuable (and growing) contributor to a robust state economy. Data centers are extremely capital-intensive and require a large amount of expensive equipment to operate. The wages for data center jobs are significantly higher than the average across all industries, and these wages have grown significantly over time (Figure 3).

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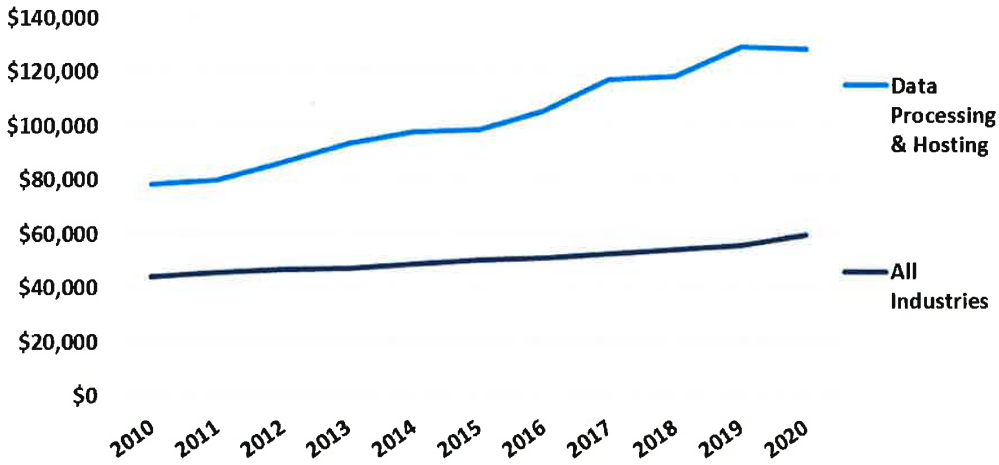
[21] Data processing and hosting is the U.S. Bureau of Labor Statistics industry category that most closely matches the data center sector.
[22] Data Source: U.S. Bureau of Labor Statistics.
[23] Data Source: U.S. Bureau of Labor Statistics.
[24] Mangum Economics, *NVTC Greater Washington Technology Sector Profile*, December 2016.

Between 2010 and 2020 the average annual pay in the data center industry in Georgia increased twice as fast as the average private-sector employee in Georgia.

- **Data center industry wages in Georgia:** 64 percent increase ($78,500 to $128,700)
- **Average private sector wages in Georgia across all industries:** 35 percent average increase in private wages across all industries ($44,300 to $59,800).

Figure 3. Trends in Average Annual Private Sector Pay in Georgia – 2010 to 2020[25]



[25] Data Sources: U.S. Bureau of Labor Statistics.

Georgia's Data Center Incentive Programs Are No Longer Competitive

DURATION OF INCENTIVE PROGRAMS ACROSS THE COUNTRY

Data centers, like most capital-intensive businesses, make long-term investment decisions where the financial conditions are most secure due to the long-term nature of their investment. Companies who build and operate data centers want to choose a location where they can confidently predict their tax liability years into the future, especially if they want to expand their presence over the long-term. A recent report by Cushman and Wakefield states, "A majority of states throughout the U.S. now offer state-level incentives, often sales- or property-tax abatements for long-term investment."[26] The competition among states for data centers is significant, and data centers carefully evaluate the business climate in various states when making location decisions.

Georgia

Georgia is one of many states that offer incentives to encourage data centers to locate or expand in their states. There are two incentives under which data centers may qualify for sales and use tax exemptions on qualifying purchases depending on their business models and other factors.

Georgia High-Tech Business Incentive O.C.G.A. § 48-8-3(68) (program sunsets and benefit ends June 30, 2023). Until this year, this program provided data centers with certainty and predictability around their investments as they contemplated location and expansion in Georgia. However, the 2023 sunset added in March 2021 likely impacts the business certainty. This incentive, which applies to any company included in the listed NAICS codes (e.g., single-user data centers, software publishers, computer systems design businesses, telecommunications firms, financial transaction processing facilities, and R&D centers) that makes a minimum $15 million investment in qualifying computer equipment, provides a full sales and use tax exemption.

This incentive can be used by traditional data center operators as well as by businesses that depend on large quantities of data to such a degree that they choose to have full control over their data centers, but whose total investment is less than the $100 to $250 million required by the 68.1 exemption (noted below). An example of an essential, Georgia company that has made use of the High-Tech incentive is UPS. Although UPS is not considered a "high-tech company," a significant number of its employees work at a large data center that it owns near its Georgia headquarters. The Georgia data center is one of the data centers that UPS uses for its global tracking and operating services network.

Georgia Data Center Incentive O.C.G.A. § 48-8-3(68.1) (program sunsets and benefit ends December 31, 2028). This incentive applies to data centers that make a minimum investment of $100 million to $250 million (the investment threshold is dependent on the population of the county) and create 20 new jobs within seven years of qualifying for the incentive. It provides an exemption from sales and use

[26] Cushman & Wakefield Data Center Advisory Group, *Data Center Global Market Comparison*, 2021.

taxes on computers, computer equipment, backup generators, air-handling units, cooling towers, energy-storage equipment, energy-efficiency technology, and other items.

Other States

Georgia's data center sales and use tax incentive programs now have a short span relative to most other states with a data center incentive program, which will impact the state's competitiveness for new data center investment and expansion of existing data centers. In a 2020 report, JLL indicated that, "Revised economic incentives have helped lure colocation operators" to the Atlanta data center market.[27] Twenty-six states have incentives that last for 10 years or more, with 11 states having incentives that are valid indefinitely. Examples in the Southeast include:

- Alabama offers up to a 30-year sales and use tax exemption. (AL 40-9B-3)[28]
- Mississippi's 10-year sales and use tax exemption has no program sunset. (MS 57-113-25)[29]
- North Carolina's sales and use tax exemption has no program sunset. (NC 105-164.13)[30]
- South Carolina's sales and use tax exemption sunsets for new applicants in 2031 with benefits ending in 2041. (SC 12-36-2120)[31]
- Tennessee's sales and use tax exemption and reduced tax on electricity has no program sunset. (TN 67-6-206)[32]
- Virginia's sales and use tax exemption sunsets at the end of 2035. (VA 58.1-609.3)[33]

As noted at the beginning of this report, there appears to be strong evidence that Georgia's data center incentives have contributed to the strong growth of data centers in the state. Given the longer-term benefit that data centers are eligible for in neighboring states, Georgia has a competitive disadvantage in attracting new data center growth because its benefits are much shorter in duration. This also can impact decisions around planned projects that have not yet broken ground.

States with existing sales and use tax incentives revise and extend them from time to time to make them more attractive. Several states have recently added, enhanced, or renewed their sales and use tax incentives in 2020 and 2021 to enhance their competitiveness.

Southeast

- Virginia revised its sales and use tax exemption to require fewer new employees and less capital investment for data centers that locate where the unemployment and poverty rates are higher than statewide averages.[34]

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[27] JLL, Data Center Outlook, H1 2020.
[28] http://alisondb.legislature.state.al.us/alison/CodeOfAlabama/1975/135558.htm and Alabama Department of Revenue, *General Summary of State Taxes*.
[29] Mississippi Tax Incentives, Exemptions and Credits.
[30] North Carolina Data Center Sales and Use Tax Exemptions.
[31] South Carolina Department of Revenue Ruling #13-5.
[32] Changes in Requirements for a Qualified Data Center, Tennessee Department of Revenue.
[33] Rich Miller, "Virginia Extends Data Center Economic Incentives," *Data Center Frontier*, March 14, 2016.
[34] Dan Swinhoe, "Virginia lowers threshold for data center tax exemption," *Data Center Dynamics*, March 31, 2021.

East

- Pennsylvania's original incentive was ineffective at attracting data center investment to the state while billions of dollars of investments were being made in nearby states. The legislature enacted a new sales and use tax exemption that is open indefinitely with benefits available for at least 15 years. (72 PS 9931-D)[35]
- Connecticut became the latest state to add a completely new data center incentive. Depending on the size and location of the facility, data centers could be exempted from state sales and use taxes for 20 to 30 years. (CT Public Act 21-1, HB 6514)[36]
- Maryland enacted a new sales and use tax incentive with a benefit period of 10 to 20 years, depending on the level of investment. The incentive has no sunset date. (MD 11-239)[37] Following the enactment of Maryland's data center incentive, a data center developer announced plans for a new 2,100-acre data center campus in the state.[38]

Midwest

- North Dakota enacted a data center incentive to replace an incentive that expired in 2020. The new incentive has no sunset date or limitation on the benefit period. (NDCC 57-39.2-04.17)[39]

West

- Arizona revised and extended its data center sales and use tax exemption by 10 years to run through 2033. The benefit period ranges from 10 to 20 years, with the 20-year benefit reserved for data centers that are considered a sustainable redevelopment project. (AZ 41-1519)[40]
- Idaho enacted a new sales and use tax exemption for data center equipment used in new data centers. The new incentive has no program sunset or limitation on the benefit period. (63-3622V)[41]
- Utah expanded its sales and use tax exemption for data centers with no minimum investment or employment criteria and no program sunset. (UT 59-12-104)[42]

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[35] Pennsylvania Brings in Data Center Tax Breaks.
[36] Matt Pilon, "In a crowded pond, CT goes fishing for data centers with new incentives," *Hartford Business Journal*, April 19, 2021.
[37] Maryland Department of Commerce, Data Center Tax Incentive Program.
[38] Rich Miller, "Quantum Loophole Plans 2,100 Acre Data Center Campus in Maryland," *Data Center Frontier*, June 28, 2021.
[39] North Dakota Century Code § 57-39.2-04.17.
[40] Dan Swinhoe, "Arizona extends data center tax breaks for another 10 years," *Data Center Dynamics*, April 27, 2021.
[41] HB 521.
[42] Utah Sales and Use Tax General Information, Revised 6/21 and SB 114.

COMPETITION BETWEEN STATES

New York – New Jersey – Connecticut

New Jersey is debating adding an incentive. There is a growing realization that the New York-New Jersey region lost its lead in the data center market to Northern Virginia, at least in part because New Jersey is not competitive with other markets on taxes.[43]

An even more dramatic illustration of the sensitivity of data centers to tax changes is the way in which data centers showed their mobility in response to a potential increase in taxes in New Jersey. In the summer of 2020, some elected state officials proposed imposing a 25/100th of one percent or a 1/100th of one percent tax on financial transactions processed in data centers located in New Jersey.[44] In the fall of 2020, the New York Stock Exchange ran its financial transactions out of its data center in Chicago for five days to practice for any possible relocation of the market to data centers outside of New Jersey. The Governor of Texas was involved in attempting to attract Nasdaq to migrate its data center operations to Dallas, the second-largest data center market in the United States. In the spring of 2021, the state of Connecticut enacted a data center incentive to make that state a viable alternative, in the event that New Jersey proceeded with the financial transaction tax.[45]

Illinois – Indiana

In June of 2019, Illinois added a new data center incentive.[46] Although the Chicago area is one of the largest data center markets in the United States, it was not keeping pace with the growth of data centers in the markets of Northern Virginia, Dallas, and Phoenix – all located in states that provide sales and use tax exemptions to attract data center investment. Since the enactment of the Illinois incentive, several new large data center projects have been announced in the state, and over $5 billion in additional data center investment has been committed making it one of the fastest-growing states in terms of data center activity.[47] The neighboring state of Indiana also enacted a 50-year sales and use tax exemption for data centers to attract data centers to the Indiana suburbs of Chicago.[48]

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[43] See Rich Miller, "Will Tax Incentives Jump-Start NJ's Data Center Industry?," *Data Center Frontier*, January 28, 2020. "Twenty years ago, New Jersey probably led the country and data center space, but we haven't moved the needle at all in 20 years." – Gil Santaliz, NJFX "New Jersey was once a hotbed of data center activity, with thriving markets for colocation and financial data centers. The state maintains a substantial and strategically important data center community, but the hottest leasing action has shifted elsewhere, primarily to Northern Virginia." "There is a bill being looked at, and it looks very similar to the broad strokes of what you see in Virginia." – Santaliz

[44] Alex Alley, "NYSE and Nasdaq threaten to leave New Jersey if transaction tax goes ahead," *Data Center Dynamics*, October 20, 2020.

[45] Matt Pilon, "In a crowded pond, CT goes fishing for data centers with new incentives," *Hartford Business Journal*, April 19, 2021.

[46] Ally Marotti. "Data center boosters hope new tax incentives 'stop the bleeding,' keep tech sites in Illinois," *Chicago Tribune*, June 2019.

[47] Companies announcing large data center projects in Illinois since the enactment of the incentive include Aligned Energy, Facebook, Prime Data Centers, NTT, and Stream.

[48] Indiana General Assembly 2019, Indiana House Bill 1405.

Data Center Incentives Do Not Diminish State Tax Revenues

With so many states offering data center sales and use tax incentives, state tax incentives intended to attract data centers do not diminish state tax revenues because data centers generally avoid locating and expanding in states without a sales and use tax exemption. States that do not attract new data center investment do not receive the additional tax revenue and economic impact from data centers. Consequently, when data centers locate in states with sales and use tax exemptions, there is no lost state revenue. States with sales and use tax exemptions for data centers are recognizing that forgoing direct sales and use tax revenue is necessary to gain the economic impact that data centers bring, along with the tax revenue associated with that economic impact.

In June of 2019, Virginia's Joint Legislative Audit and Review Commission (JLARC) published an evaluation of the state's data center incentive using confidential tax information that is not publicly available.[49]

JLARC found that up to 90 percent of the data center investment made by the companies that received the sales and use tax exemption would not have occurred in the state of Virginia without the incentive. So, the "cost" of the State data center incentive is only 10 percent of the amount of State sales tax revenue exempted. Using the confidential tax information, JLARC estimated the economic and government budgetary impact of Virginia's data center sales and use tax exemption.[50]

JLARC determined that in 2017 (the latest year for which data was available for the evaluation) data centers generated $4.7 million more state tax revenue from construction and suppliers than the amount of sales and use tax exempted by Virginia's data center incentive.[51] In 2017, the State took in $1.09 in state tax revenue from data center-related activity for every one dollar of potential state tax revenue that was exempted from qualifying data centers.

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[49] Joint Legislative Audit and Review Commission, *Data Center and Manufacturing Incentives, Economic Development Incentives Evaluation Series*. June 17, 2019.

[50] *Appendix N: Results of economic and revenue impact analyses*.

[51] Mangum Economics, *The Impact of Data Centers on the State and Local Economies of Virginia, 2020. Also, see Appendix N: Results of Economic and Revenue Impact Analyses*.

The Potential for Future Jobs and Investment Growth in Georgia

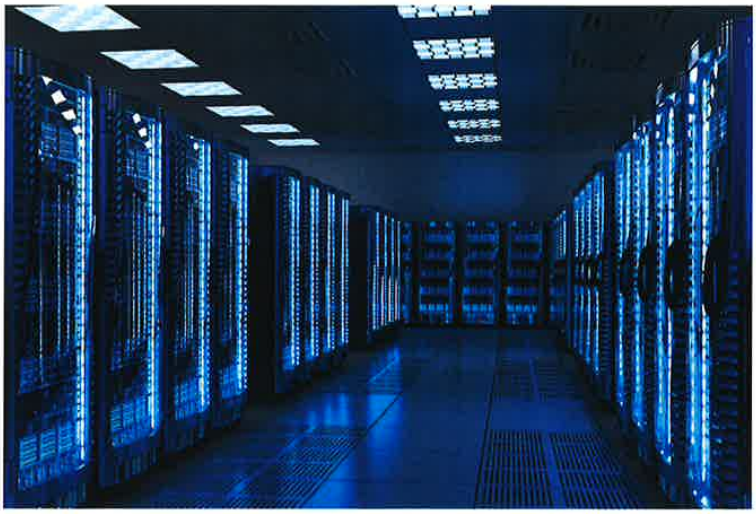
It is possible to estimate the potential impact on jobs and economic growth in Georgia if the state's data center incentives are made competitive with other states that offer an incentive. We do this by estimating the volume of new data center projects that could locate in Georgia instead of another state, and then calculating the jobs, pay and benefits, and economic output associated with those facilities.

Research by Virginia's Joint Legislative Audit and Review Commission estimated that 90 percent of the data center projects that received tax incentives in Virginia would have been located in another state if Virginia's data center incentives were not in place. If we infer that the same would be true in Georgia (where data center market growth has been six percent per year over the last eight years), we can estimate that over 10 years **Georgia's data center market will grow by 60 percent instead of six percent, if Georgia's data center incentives are extended for at least 10 years.**

If Georgia remains competitive for data center growth over the next 10 years, as new data center investment and jobs sited in Georgia could gain:[52]

- $3.1 billion in economic output activity, including:
- 13,950 jobs, and
- $887 million in pay and benefits.

For context, that impact is roughly the equivalent of gaining seven to eight new hyperscale data centers (described earlier in this report) over the ten-year period. That result is likely if the newly enacted sunsets on Georgia's data center incentive programs are removed.



[52] This is based on estimates of the impact of data center construction and operation jobs over the last year and extrapolating to a 10-year period with both potential growth rates.

Table 3 shows the estimated impacts of data centers 10 years out with and without the incentives and (in the final column) the difference in year ten.

Table 3. Summary of One-Year Total Economic Impact of Data Centers in Georgia (2021 dollars)*

10th Year 1st Round Direct Effects	With Incentives Renewed	Without Incentives Renewed	Gained Impacts with Incentives Renewed
Data Center Construction Jobs	1,630	160	1,470
Data Center Construction Pay & Benefits	$111,400,000	$11,100,000	$100,300,000
Data Center Construction Output	$262,400,000	$26,200,000	$236,200,000
Data Center Operation Jobs	5,570	3,690	1,880
Data Center Operation Pay & Benefits	$441,300,000	$292,300,000	$149,000,000
Data Center Operation Output	$1,917,100,000	$1,270,100,000	$647,000,000
10th Year 2nd Round Indirect Effects			
Data Center Construction Supported Jobs	1,150	120	1,030
Data Center Construction Supported Pay & Benefits	$67,200,000	$6,700,000	$60,500,000
Data Center Construction Supported Output	$207,500,000	$20,800,000	$186,700,000
Data Center Operation Supported Jobs	28,350	18,780	9,570
Data Center Operation Supported Pay & Benefits	$1,710,200,000	$1,133,000,000	$577,200,000
Data Center Operation Supported Output	$6,052,300,000	$4,009,700,000	$2,042,600,000
Total Impact			
Total Jobs Impact in Georgia	**36,700**	**22,750**	**13,950**
Total Pay & Benefit Impact in Georgia	**$2,330,100,000**	**$1,443,100,000**	**$887,000,000**
Total Output Impact in Georgia	**$8,439,300,000**	**$5,326,800,000**	**$3,112,500,000**

* Amounts may not sum due to rounding.

About Mangum Economics, LLC

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

- *The Impact of Data Centers on the Arizona Economy, 2021;*
- *Potential Impact of the Development of the Offshore Wind Energy Industry on Hampton Roads and Virginia*, 2020;
- *The Potential Impact of a Data Center Incentive in Maryland*, 2020;
- *The Impact of Data Centers on the State and Local Economies of Virginia*, 2016, 2018, and 2020;
- *Opportunities for Southside Virginia to Participate in the Cloud Economy*, 2019;
- *The Economic and Fiscal Contribution that Data Centers Make to Virginia: Spotlight on Prince William County*, 2018; and
- *The Potential Impact of a Data Center Incentive in Illinois*, 2018.

POLICY ANALYSIS

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

ECONOMIC IMPACT ASSESSMENTS AND RETURN ON INVESTMENT ANALYSES

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

CLUSTER ANALYSIS

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

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The Impact of Data Centers on the Arizona Economy

PREPARED BY

MANGUM economics

FOR

DATA CENTER COALITION

FEBRUARY 2021

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About The Data Center Coalition

The Data Center Coalition (DCC) is the trade association that empowers the data center industry through education, public policy, and community engagement. The DCC represents and advances the interests of the data center industry by aggregating industry expertise and thought leadership, partnering with policymakers and other stakeholders, and supporting data center communities through active engagement. Its advocacy efforts focus on promoting a strong business climate, public policies, and investments. Its community efforts focus on driving economic growth, workforce development and diversity, and sustainability initiatives. To learn more, go to https://www.datacentercoalition.org/.

Executive Summary

Phoenix has a large, rapidly growing data center market. The data center development around the city has fostered the development of a strong tech workforce with rapidly growing employment and wages.

We estimate that in 2020 data centers in Arizona directly provided approximately:

- 2,020 construction jobs,
- $132.4 million in associated construction pay and benefits,
- 530 full-time-equivalent data center operations jobs,
- $42 million in associated data center employee pay and benefits, and
- $539.1 million in economic output from construction and operations combined.

Taking into account the economic ripple effects that direct investment generated, we estimate that the total impact on Arizona from data centers in 2020 was approximately:

- 7,470 jobs (including 80 jobs outside of the Phoenix area),
- $460.2 million in associated employee pay and benefits, and
- $1.5 billion in economic output.

Arizona offers qualifying data centers a transaction privilege and use tax exemption on qualifying equipment as an incentive to encourage data center investment and jobs in the state. Even with this exemption in place, data centers pay millions of dollars in state and local taxes. In addition to the taxes paid directly by data centers, local governments and the State of Arizona collect tax revenue from the secondary indirect economic activity that data centers generate. We estimate that in 2020, data centers directly and indirectly generated a minimum of $85 million in state and local tax revenue in Arizona. This is an underestimate of the true state and local tax revenue associated with the industry because we lack sufficient data to properly estimate several important sources of tax revenue.

At the local level, data centers provide far more in county or city tax revenue than they and their employees demand in local government services. In other markets, data centers have been estimated to generate between $8 and $17 in local tax revenue for every dollar local governments spend on public services for employees and their families. This has enabled local governments to keep residential property taxes up to 20 percent lower than would be the case absent data center revenue.

Data center tax incentives have been shown not to burden state coffers. In June of 2019, Virginia's Joint Legislative Audit and Review Commission found that 90 percent of the data center investment made by the companies that received the sales and use tax exemption would have occurred in other states except for the exemption. In fact, in 2017, the data center tax incentive in Virginia generated $1.09 of State tax revenue for every dollar that it exempted.

Arizona is one of 33 states that offer incentives for data centers that locate or expand in their states. Several states have recently added, enhanced, or renewed their incentives to remain competitive.

Introduction to Data Centers in Arizona

The pandemic has reminded us that there are viruses that are more threatening than those that damage our hard drives. In order to socially distance for public health reasons and yet still remain productive, we have demanded more of our digital infrastructure. Data centers enable schools at every level to continue education online. Data centers provide mission-critical technology that enables communications for emergency 911 systems and hospitals. Hospitals, clinics, doctors' offices, health insurers, and patients rely on data centers to store, transmit, and secure medical records and images. Medical researchers store, process, analyze, and access enormous volumes of information in data centers in the search for vaccines and treatments. We go to work on virtual private networks, remotely accessing confidential documents and customized software in the cloud. Conferences now exist almost exclusively through webinars. Face-to-face business meetings still take place, but mostly they are only head-and-shoulders video collaborations.

Data centers are more than just the warehouses for our digital lives. They are also the generators of much of the interactive digital content that we use. Data centers are home to the artificial intelligence that gives us personalized shopping recommendations, helps us with on-the-move driving directions, tries to match us with people with similar interests, offers us digital grocery coupons, and informs us about status of our bank accounts and internet service.

In 2012, IBM published an estimate that 90 percent of all data have been created in the last two years.[1] In other words, in 2012, the total amount of data was increasing by ten times every two years. At that rate, from 2010 to 2020 the total amount of data increased by 100,000 times. Now consider that the IBM estimate was made prior to the widespread adoption of commercial connected sensors and smart consumer appliances. The dramatic expansion of artificial intelligence, machine learning, and augmented reality are all putting ever-increasing demands on data centers. The development, growth, and evolution of these advanced technologies now means that data is creating its own data. So, it is quite likely that the rate of growth of data is far greater than in 2012. We have not yet reached "peak data center."

In addition, with the rollout of 5G technology to wireless networks, the shape of the industry is changing. Edge data centers that are relatively smaller than large cloud data centers are sited near places where people congregate and move. However, edge data centers will not become substitutes for large enterprise data centers or cloud data centers. Instead, edge data centers will be constructed as a complement to large data centers as the data center industry continues to grow and evolve to meet the demands of new technology.

Data centers have emerged as leading innovators at the forefront of increasing operational efficiency in the use of energy and water.[2] Among other innovations, data centers have used digitization, advanced

[1] David Greer, "System z Helps Address the Data Analytics Power Crunch," *IBM Systems magazine*, April 2012.
[2] https://www.osti.gov/servlets/purl/1372902/

sensors, and machine learning (within data centers) to dramatically reduce energy and water consumption. For example, Google has been able to reduce the amount of energy used for cooling in its data centers by up to 40 percent, reducing overall energy usage in its data centers by 15 percent on top of previous efficiency enhancements.[3] Data center companies have also made large commitments to the purchase of energy from renewable sources. For utility companies to move to different and initially costlier sources of renewable power, they need this kind of commitment to provide a stable demand to ensure that the large upfront investments that are required are financially sustainable.

This report quantifies the significant contribution that this dynamic and rapidly evolving industry makes to the state of Arizona.

[3] https://deepmind.com/blog/article/deepmind-ai-reduces-google-data-centre-cooling-bill-40

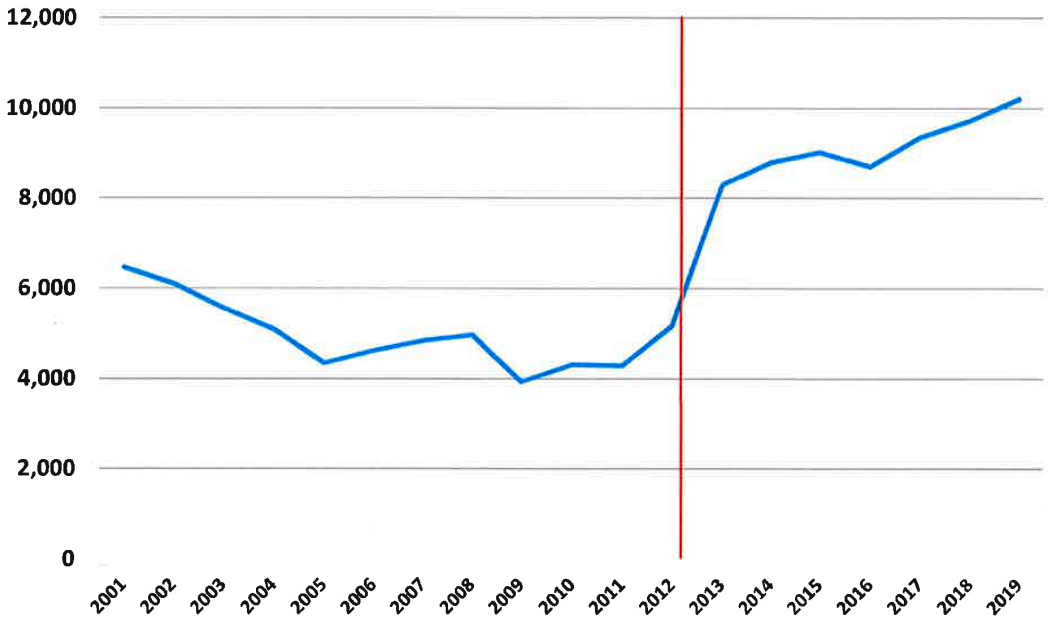
ECONOMIC PROFILE OF DATA CENTERS IN ARIZONA

Arizona provides an excellent location for data centers. The risk of environmental and natural disasters is low, open land is abundantly available, utility prices are relatively low, and there is a well-established pool of skilled tech workers.

THE UPWARD TREND IN ARIZONA'S TECH LABOR MARKET

Figure 1 shows the trend in private sector statewide data processing employment from 2001 through 2019. Data processing employment in Arizona generally declined between 2001 and 2009, but it has since escalated rapidly to 10,203 jobs in 2019. That change to the uptrend in employment coincides with 2013, the year that Arizona implemented its data center incentive to make the state more competitive with other states in attracting data centers.

Figure 1. Data Processing Private Sector Employment – 2001 to 2019[4] (red line indicates enactment of data center incentive)



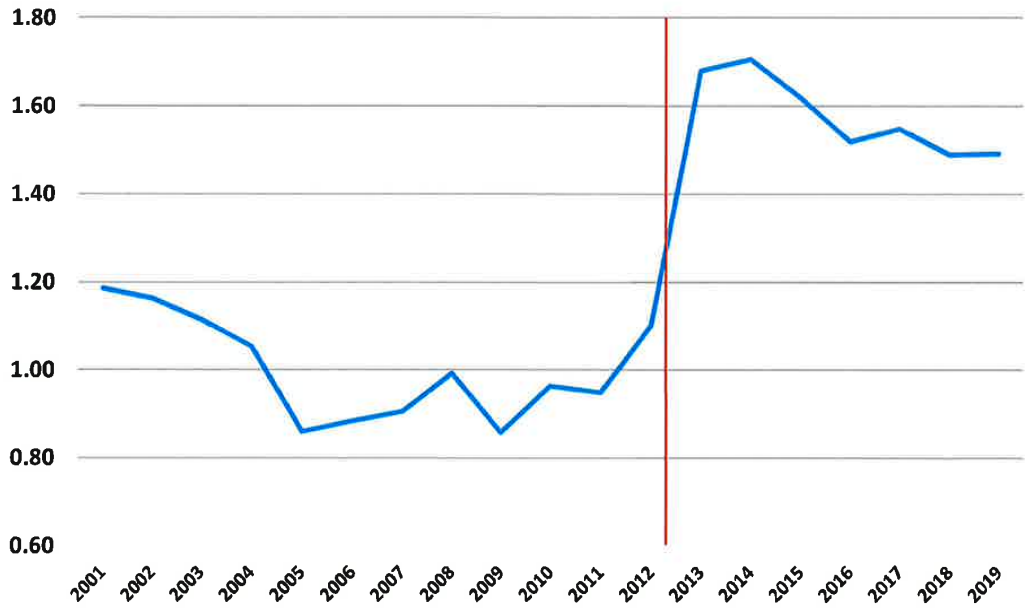
Research has shown that data centers share the pool for high-tech labor with industries such as architecture, engineering, computer system design, software, telecommunications, scientific research &

[4] Data Source: U.S. Bureau of Labor Statistics.

development, and technical consulting. The existence of a vibrant data center market helps to attract talent that supports all of these important industries.

The increase in data processing employment in Arizona is not just the result of a general overall nationwide increase in tech employment in the United States. Figure 2 shows the ratio of the percentage of Arizona workers in data processing to the percentage of U.S. workers nationwide in data processing. When this ratio (known as the location quotient) is above 1, Arizona has a greater concentration of tech workers than the U.S. as a whole. Figure 2 shows that since 2013 the concentration of tech workers in Arizona has been 40 percent or more greater than in the nation overall.

Figure 2. Arizona's Concentration of Data Processing Employment Relative to the U.S. Nationwide Concentration of Data Processing Employment– 2001 to 2019[5] (red line indicates enactment of data center incentive)



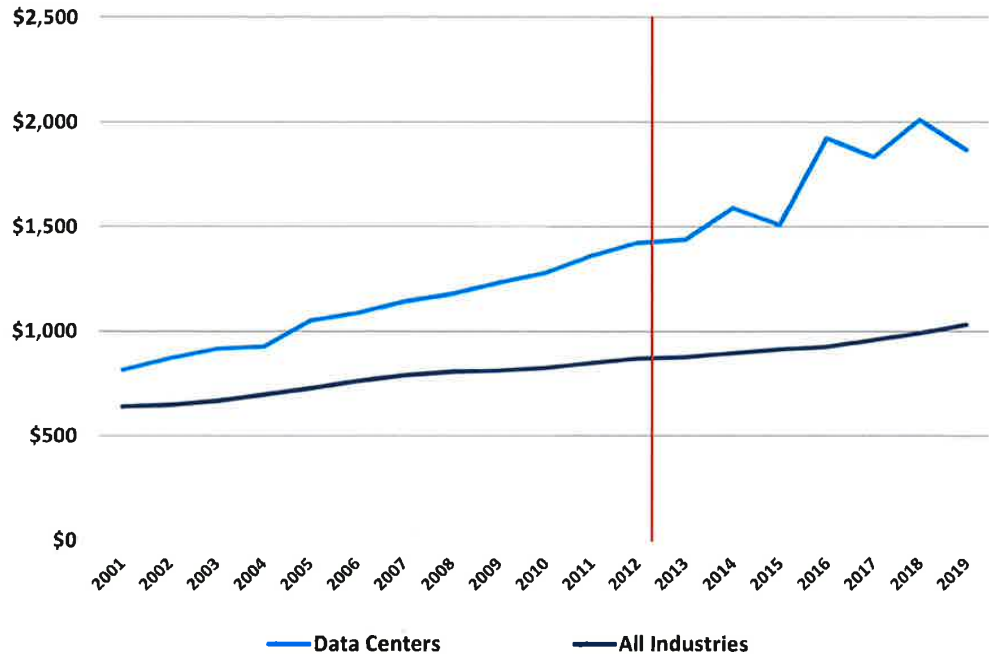
As with the overall employment statistics, the dramatic change in the concentration of tech workers in Arizona in 2013 coincides with the year that Arizona implemented its data center incentive. It is reasonable to conclude that the data center incentive has helped to create a significant and unusually strong labor market for skilled tech workers in the state. A strong tech labor market is important for attracting businesses in many industries from advanced manufacturing to machine learning.

[5] Data Source: U.S. Bureau of Labor Statistics.

One of the key characteristics of the data center industry is that it is extremely capital-intensive (a high capital to labor ratio).[6] The industry employs a relatively small number of highly skilled and highly paid professionals to operate and maintain a very large amount of very expensive equipment. Therefore, it is useful to also look at trends in private sector average annual wages in the industry.

Figure 3 illustrates how the data center industry pays wages that are much higher than the average across all industries and how those wages have grown rapidly over time. Between 2001 and 2019 the average weekly private sector wage in the data center industry in Arizona grew from $814 to $1,866 – a 129 percent increase. In comparison, over the same period average private wages across all industries in Arizona went from $638 to $1,029 – an increase of 61 percent. In other words, over the 19-year period, the average private sector employee of an Arizona data center saw their gross income go up twice as fast as the average private sector employee in Arizona.

Figure 3. Trends in Average Weekly Private Sector Wage in Arizona – 2001 to 2019[7] (red line indicates enactment of data center incentive)



This combination of rapidly rising employment and rapidly rising wages make data centers one of Arizona's most high-performing lines of business and an important (and growing) contributor to a strong and robust state economy.

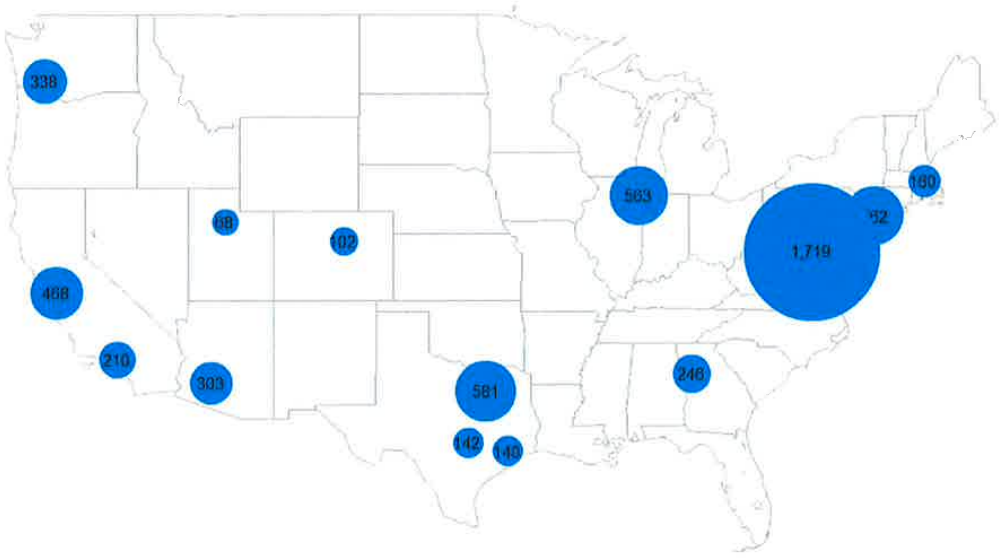
[6] As indicated below, for every job inside a data center, there are 6.5 jobs created in the Arizona economy (not including construction jobs).

[7] Data Sources: U.S. Bureau of Labor Statistics.

THE UPWARD TREND IN THE PHOENIX DATA CENTER MARKET

Figure 4 shows the 14 largest data center markets in the United States. The area of each circle indicates the relative amount of power capacity (MW labeled in black)[8] in each market.

Figure 4. Relative Sizes of Largest Data Center Markets (megawatts of power capacity) – 2020[9]



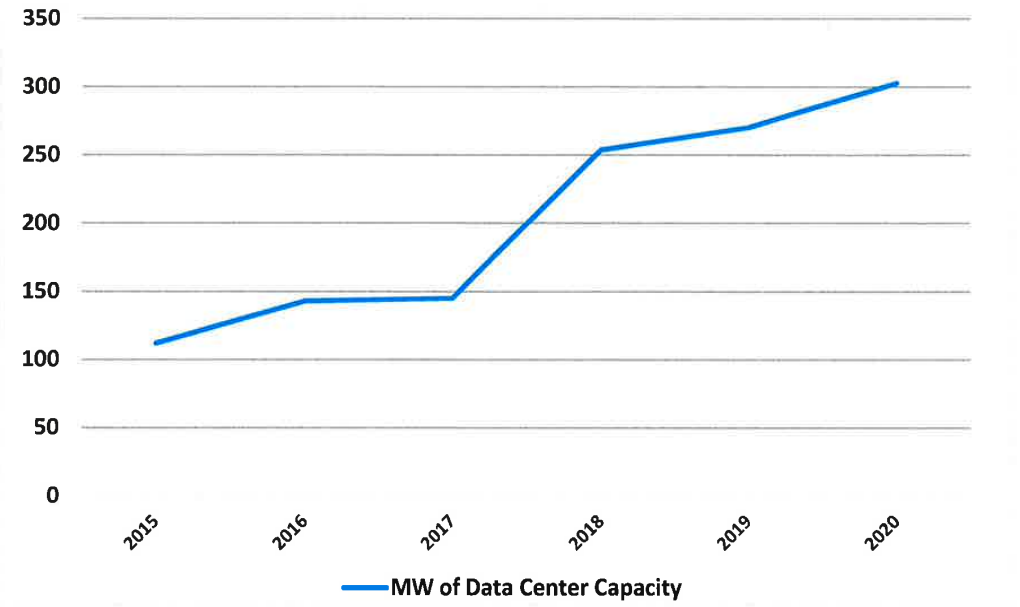
What the national map obscures is how the how the data center landscape has changed over time. The data center market in the Phoenix area has grown dramatically in the last several years. Since 2015, the amount of data center capacity in the Phoenix area has increased by 170 percent. Only Northern Virginia has grown at a faster rate (190 percent), and the only other major market that comes close to Phoenix in growth is Austin-San Antonio (154 percent growth). After that, the market with the next fasted growth rate is Dallas (73 percent).

Data centers in Phoenix are increasingly an alternative location for data centers in California, especially southern California. According to JLL, Los Angeles has the same data center capacity in 2020 that it had in 2015 (zero percent growth).

[8] Power capacity is frequently used as a measure of data center size.
[9] JLL, *Data Center Outlook, United States, H1 2020.* This chart does not include the 902 MW of data center capacity planned for the Phoenix market described below.

Figure 5 shows the increase in data center capacity (measured in megawatts of IT capacity) in the Phoenix area. The graph captures the growth in the Phoenix data center market since the enactment of the data center incentive in 2013. In only five years, data center capacity almost tripled in Phoenix.

Figure 5. Growth in the Size of the Data Center Market in the Phoenix Area – 2015 to 2020[10]



ADDITIONAL NEAR-TERM DATA CENTER DEVELOPMENT

The data center market in Phoenix is expected to continue to grow at an extraordinarily fast pace. According to JLL, in addition to the 303 MW of data center capacity already in Phoenix, 24 MW of data center capacity were under construction at the end of 2020 and 250 MW more of data center capacity is planned for the area. Some examples of planned projects include:

- Compass Datacenters' construction of a 242 MW data center on 190 acres of land in Goodyear,[11]
- Google's plan for a one-billion-dollar data center in Mesa,[12]
- Stack Infrastructure's plan for a 150 MW data center on 79 acres in Avondale,[13]
- Stream Data Centers' plan to build a 350 MW data center campus on 157 acres in Goodyear,[14] and
- Vantage Data Centers' plan for a 160 MW data center campus on 50 acres of land in Goodyear.[15]

[10] Data Sources: JLL. This chart does not include the data center capacity planned for the Phoenix market described below.
[11] Compass Datacenters, Phoenix Data Centers.
[12] Steve Burks, "Here are Arizona's biggest economic development wins of 2019," azbigmedia.com, December 3, 2019.
[13] Alex Alley, "Stack to build 150MW data center in Phoenix, Arizona," datacenterdynamics.com, June 3, 2020.
[14] Stream Data Centers, Booming in The Desert: Stream Commissions New Phoenix Data Center, October 13, 2020.
[15] Vantage Data Centers, Vantage Data Centers Expands to Phoenix Market with 50-acre Land Purchase; Plans to Build 160MW Campus, January 8, 2019.

Data Center Demand for Renewable Energy Developments

Data centers have emerged as a driving force in the transition to clean energy sources. According to a recent analysis by the U.S. Chamber of Commerce the average data center spends about $7.4 million a year on energy costs. That high demand for electricity has made data centers increasingly sensitive to how the electricity they use is produced and also how they can reduce energy usage through greater efficiency.

For example, Apple, Amazon Web Services, Facebook, Google, and Microsoft, the five largest hyperscale enterprise data center operators in the U.S., have all publicly committed to sourcing 100 percent of their power needs from renewable energy as a way to reduce their environmental impact and in some cases have already met that objective. In addition, major colocation providers such as Aligned, Digital Reality, Iron Mountain, and QTS are also making great strides in moving toward 100 percent renewable energy sourcing.

Data centers have also been at the forefront of innovations in energy efficiency. Google, for example, recently unveiled a carbon-intelligent computing platform that will reduce the company's carbon footprint by better aligning computing workloads to those times during the day when renewable energy is most readily available on the grid. In an example of even more out-of-the-box thinking, one large software company is experimenting with the use of unmanned underwater data centers and the results of those experiments show much promise. In addition to reduced cooling costs, the company has found that filling the unmanned, underwater data center with nitrogen instead of air reduces server failure to one-eighth of the norm for terrestrial data centers, thereby further reducing costs.

For reasons of both corporate responsibility and economic self-interest data centers are leaders in the transition to renewable energy and in pioneering innovative new methods for improving energy efficiency.

The Impact of Data Centers on the Arizona State Economy

The construction and ongoing operation of data centers in Arizona has large effects on the state economy. In this section, we estimate the economic impact that data centers have on the Phoenix-Mesa-Chandler MSA, where most data center activity has occurred, as well as on the impact on the state of Arizona overall. To empirically evaluate the statewide and regional economic impact attributable to data centers, we employ a commonly used regional input-output economic impact model called IMPLAN.[16]

Regional input-output economic impact modeling measures the ripple effects that an expenditure generates as it makes its way through the economy. For this report, spending on and by data centers in Arizona has a direct economic impact on the state economy in terms of people hired as data center employees, employee pay and benefits, and economic activity in the region for utilities, construction, and equipment. That direct spending by the data centers creates the first ripple of economic activity.

As data center employees and businesses (like construction contractors for data centers, power companies that supply data centers, and data center equipment suppliers) spend the money that they were paid by data center companies, they create another *indirect* ripple of economic activity that is part of the second-round effects of the data center industry.

ILLUSTRATING THE INDIRECT IMPACT OF DATA CENTERS IN ARIZONA

Many Arizona businesses are part of the data center supply chain and exist primarily because of the rapid growth of data centers in the state. These companies in turn generate economic activity and growth for other businesses in Arizona. Table 1 shows some different Arizona businesses that are part of the economic impact of data centers in the state. We are not endorsing, promoting, or commending the businesses named in Table 1. We only refer to them as illustrations of some of the types of businesses that are part of the second ripple effect of economic activity related to spending by data centers. And the list is far from complete.

[16] IMPLAN is produced by IMPLAN Group, LLC.

Table 1. Some Arizona-Headquartered Businesses Serving Arizona Data Centers[17]

Company	HQ City	Line of Business
American Cooling and Heating	Gilbert	Design, installation, and service for data center cooling systems
Bel-Aire Mechanical	Phoenix	HVAC and plumbing mechanical services
Buesing Corp	Phoenix	Civil engineering and earth moving
Crawford Mechanical Services	Gilbert	Cooling and commercial HVAC systems for data centers
DP Air	Phoenix	Design, environmental control, critical power systems, and HVAC solutions for data centers
DP Electric Inc.	Tempe	Electrical installation, service, and maintenance
LDP Associates	Phoenix	Design, layout, and equipment selection services for data centers
Serbin Studio	Goodyear	Data center design services
ServerLIFT	Phoenix	Equipment for the physical handling of rack-mounted IT equipment
Solutions i3	Oro Valley	Data center consulting services for planning & pre-design, power & cooling systems analysis, disaster recovery, and storage & data protection
Southwest Portable Air	Gilbert	Portable, temporary cooling solutions for data centers
Titan Power	Chandler	Power and air conditioning sales, installation and service; data center planning, design, and engineering
United Metal Products	Tempe	Manufacturer of outside air energy recovery, evaporative cooling, and multi-mode custom air handlers

In addition to the economic effects of the data center-to-other business transactions, there are also the second-round economic effects associated with data center employee-to-business transactions that ripple through local economies. These effects occur when data center employees buy groceries; pay rent; go out for dinner, entertainment, or other recreation; pay for schooling in Arizona; or make other local purchases. Additionally, there are the second-round economic effects of business-to-business transactions between the direct data centers and their suppliers.

[17] None of the companies named here were consulted for this report nor did they request to be included. They are included based only on our own independent research. Again, this list is by no means comprehensive. It is for illustration only.

The total impact is simply the sum of the first round direct and second round impacts. These categories of impact are then further defined in terms of employment (the jobs that are created), labor income (the pay and benefits associated with those jobs), and economic output (the total amount of economic activity that is created in the economy).

PHOENIX-MESA-CHANDLER, ARIZONA METROPOLITAN STATISTICAL AREA (MSA)

We estimate that the construction and operation of data centers in 2020 in the Phoenix-Mesa-Chandler MSA directly provided approximately:

- 2,020 construction jobs,
- $132.4 million in associated construction pay and benefits,
- 520 full-time-equivalent data center operations jobs,
- $41.7 million in associated data center employee pay and benefits, and
- $536.1 million in economic output from construction and operations combined.

Taking into account the economic ripple effects generated by that direct impact, we estimate that the total impact on the Phoenix-Mesa-Chandler MSA of the construction and operation of data centers in 2020 was approximately:

- 7,390 jobs,
- $456.1 million in associated employee pay and benefits, and
- $1.5 billion in economic output.

Table 2. Economic Impact of Data Centers in the Phoenix-Mesa-Chandler MSA in 2020 (2020 dollars)

1st Round Direct Effects	Jobs	Pay	Economic Output
Data Center Construction	2,020	$132,400,000	$332,200,000
Data Center Operation	520	$41,700,000	$203,900,000
2nd Round Indirect and Induced Effects			
Data Center Construction	1,470	$83,800,000	$259,000,000
Data Center Operation	3,390	$198,200,000	$668,700,000
Total Impact			
Total Economic Impact in the Phoenix-Mesa-Chandler MSA	**7,390**	**$456,100,000**	**$1,463,900,000**

ARIZONA STATEWIDE

We estimate that in 2020 data centers in Arizona directly provided approximately:

- 2,020 construction jobs,
- $132.4 million in associated construction pay and benefits,
- 530 full-time-equivalent data center operations jobs,
- $42 million in associated data center employee pay and benefits, and
- $539.1 million in economic output from construction and operations combined.

Taking into account the economic ripple effects generated by that direct impact, we estimate that the total impact on Arizona from data centers in 2020 was approximately:

- 7,470 jobs (including 80 jobs outside of the Phoenix area),
- $460.2 million in associated employee pay and benefits, and
- $1.5 billion in economic output.

For every job inside a data center, there are 6.5 jobs created in the Arizona economy (not including construction jobs).

The statewide numbers are slightly higher than the Phoenix MSA numbers for two reasons. First, there are a few small data centers in the Tucson area. Those increase both the direct and indirect impacts. Additionally, a small amount of the data center activity in the Phoenix area spills over to the rest of the state creating some jobs, pay, and economic output outside of Maricopa and Pinal counties.

Table 3. Economic Impact of Data Centers in Arizona in 2020 (2020 dollars)

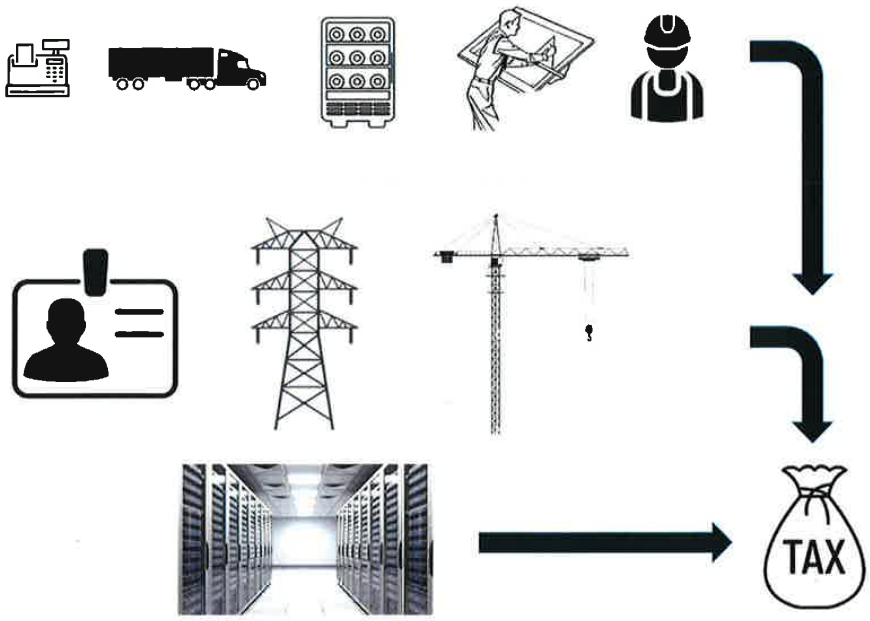
1st Round Direct Effects	Jobs	Pay	Economic Output
Data Center Construction	2,020	$132,400,000	$332,200,000
Data Center Operation	530	$42,000,000	$206,900,000
2nd Round Indirect and Induced Effects			
Data Center Construction	1,470	$84,300,000	$260,800,000
Data Center Operation	3,450	$201,500,000	$680,000,000
Total Impact			
Total Economic Impact in Arizona	**7,470**	**$460,200,000**	**$1,479,900,000**

DATA CENTERS GENERATE STATE AND LOCAL TAXES EVEN WITH INCENTIVES

Data centers pay millions of dollars in state and local taxes, even in states that have sales and use tax exemptions on some data center equipment. All data centers pay state employer withholding taxes, utility taxes and other taxes which may include corporate income tax. At the local level, they pay real estate taxes, tangible personal property taxes, business license taxes, and industrial utility taxes.

In addition to the taxes that data centers pay directly, the economic activity that they generate also results in additional tax collections. Figure 6 illustrates the sources of tax revenues associated with data centers. On the bottom row, many data centers in Arizona pay taxes directly to federal, state, and local governments. On the second row, the employees and business suppliers that are paid directly by the data centers also pay taxes; and, additionally, on the third row, the people and businesses that are paid by the employees and suppliers of data centers pay taxes. All of these sources of tax revenue are included in the tax revenue estimates described in this report.

Figure 6. Sources of Tax Revenue Associated with Data Centers



STATEWIDE AND LOCAL TAX COLLECTIONS ASSOCIATED WITH DATA CENTERS

In addition to the taxes paid directly by data centers, local governments and the State of Arizona collect tax revenue from the secondary indirect and induced economic activity that data centers generate. Table 4 shows our estimate of the tax revenues directly and indirectly generated by data centers statewide in Arizona and in the Phoenix-Mesa-Chandler MSA in 2020 through that first round and second round economic activity. However, we do not have data to fully estimate several important sources of state and local tax revenue.

To the best of our knowledge, all operational data centers in Arizona are in Maricopa and Pima Counties.[18] Taxes owed for 2020 on real property in those counties is available. Therefore, the $20 million estimate in the second column of Table 4 is a very solid estimate.

Taxes owed on business personal property in those counties is similarly available for enterprise data centers and for colocation data center landlords. However, it is not possible to obtain business personal property taxes owed by the tenants of colocation data centers. Tax records show that in 2020 over $8 million in business personal property tax was paid by enterprise data centers and colocation data center landlords. Based on our own research and proprietary modeling, we estimate that in 2020 colocation tenants paid at least $10 million in business personal property tax. Therefore, the $18 million estimate in the third column of Table 4 is an underestimate of the business personable property tax revenue associated with data centers.

We are unable to estimate the amount of utility taxes that data centers pay to local governments and to the State of Arizona. Utility rates vary by the amount of power purchased, and the amount of power purchased varies significantly from region to region and facility to facility. Generally, newer facilities are more energy efficient. We are not able to reliably model the amount of power used or the utility taxes paid. However, we are confident that total local utility taxes exceed one million dollars annually and state utility taxes exceed two million dollars annually.

Finally, we are unable to estimate the transaction privilege tax (TPT) on construction, which is probably very significant. The way in which the numerous exemptions are crafted makes it impossible for us to make a reasonable estimate of the amount of TPT paid on data center construction projects without having an extensive level of detailed knowledge of each construction project.

Our input-output economic modeling allows us to estimate the state and local tax revenues generated by data center employees, suppliers, and those people and businesses with whom they trade. Those estimates are provided in the fourth column of Table 4.

We estimate that in 2020 data centers were directly and indirectly responsible for generating in excess of $85 million in state and local tax revenue in Arizona.

[18] There are a few small data centers in Pima County.

Again, $85 million in state and local tax revenue is a vast underestimate of the actual tax revenue generated by data centers in Arizona.

Table 4. 2020 Estimatable Tax Revenue Directly and Indirectly Generated by Data Centers in Arizona

Region and Phase	Local Real Estate Tax Revenue	Local Business Personal Property Tax Revenue	Indirect Tax Revenue	Utility Tax Revenue	Total Estimatable Tax Revenue
Phoenix MSA/ Operations Phase	$20,000,000+	$18,000,000+	$12,000,000+	$1,000,000+	$51,000,000+
Phoenix MSA/ Construction Phase			$6,000,000+		$6,000,000+
Total for the Phoenix MSA					**$57,000,000+**
Arizona Outside the Phoenix MSA/ Operations Phase			$18,000,000+	$2,000,000+	$20,000,000+
Arizona Outside the Phoenix MSA/ Construction Phase			$8,000,000+		$8,000,000+
Total for Arizona Outside of the Phoenix MSA					**$28,000,000+**

GENERAL CONTRIBUTION TO LOCAL GOVERNMENT BUDGETS

Because the data centers spend far more on capital equipment and utilities than they do on full-time, in-house employees, they provide a large amount of property tax revenue for local governments. Additionally, the industry also places downward pressure on overall tax rates, thereby improving the locality's business climate and economic attractiveness.

An important and relatively unusual characteristic of the computer servers and switches that are housed in data centers affects how data centers make unusually large and consistent contributions to local government revenues via business personal property taxes. Unlike most business personal property that has a useful life of 10 years or more, data center personal property is replaced on a 3- to 5-year cycle. This means that 20 to 30 percent of the computer equipment in data centers is never more than one year old and it is on the tax rolls at close to its fair market value. So, the business personal property tax revenues associated with data centers do not diminish to the same extent that the business personal property does in other industrial and commercial businesses.

High Local Benefit-to-Cost Ratio that Reduces the Tax Burden on Local Residents

Data centers provide a high benefit-to-cost ratio in terms of the tax revenue they generate relative to the government services that they and their employees require. For local governments, data centers provide high amounts of consistent property tax revenue while placing few demands on local government services, like schools and emergency services, and imposing few burdens like traffic congestion on local neighborhoods.

By way of illustration, in a study on the effect of data centers on the state of Virginia we were able to quantify the benefit-to-cost ratio of data centers for local governments.[19] We provide these statistics from Virginia localities because they illustrate what is likely to be true in localities in Arizona.

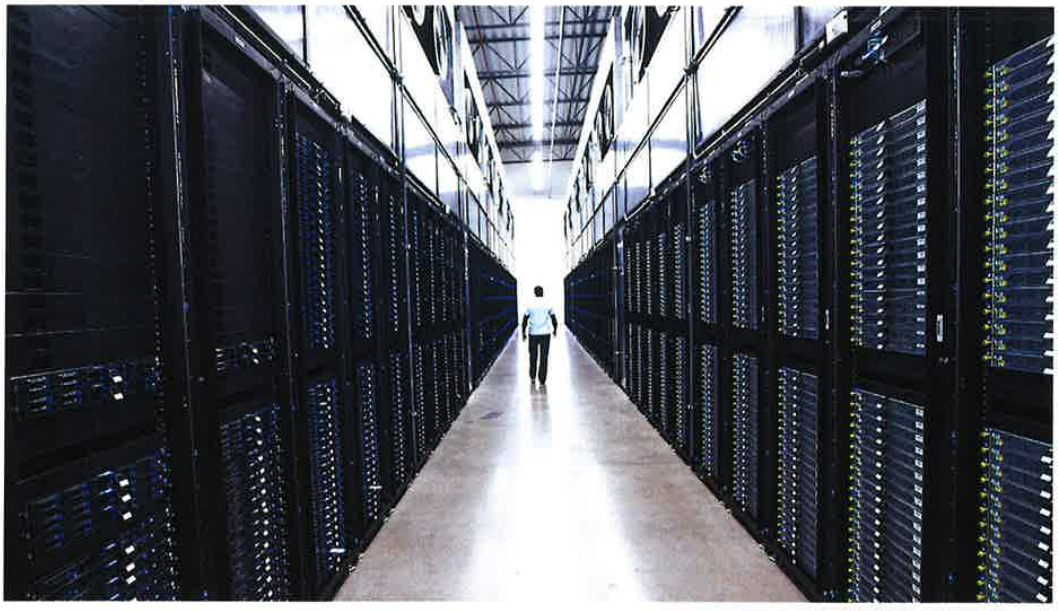
Loudoun County, Prince William County, and Henrico County are home to the most significant concentrations of data centers in Virginia. County staff in those localities were able to provide us with detailed data on the tax revenue generated by data centers in each locality from real and business personal property taxes.[20] As a result, we are able to use those data in combination with data from other sources to compute the benefit-to-cost ratio associated with the data center industry in each locality. As shown in Table 5, the benefit-to-cost ratios that we calculated in that study ranged from 8.6 to 1 up to 17.8 to 1.

[19] Mangum Economics, *The Impact of Data Centers on the State and Local Economies of Virginia, 2020.*
[20] It should be noted that, of necessity, these estimates exclude BPOL and other local taxes that also apply to the data center industry. As a result, the revenue estimates provided almost certainly under-estimate the actual local tax revenues generated by data centers.

Table 5. Estimated Benefit-to-Cost Ratio Associated with the Data Center Industry and Employees in 2018

Locality	Estimated Tax Revenue (Benefit)	Estimated Budgetary Cost	Benefit/Cost Ratio
Henrico County, VA	$3,784,000	$442,000	8.6
Loudoun County, VA	$266,623,000	$17,672,000	15.1
Prince William County, VA	$35,802,000	$2,006,000	17.8

These benefit-to-cost ratios mean that data centers provide local tax revenues that would otherwise need to be supplied by increases in residential property taxes or increases in taxes on other types of businesses to maintain the same level of public services. In our Virginia report, we had data from the county governments that showed that local residential tax rates would have had to increase anywhere from one to 21 percent in order to make up for revenue that was otherwise supplied by data centers.



Data Center Incentives in Arizona

Qualified data center facilities and their qualified tenants in Arizona can qualify for a limited duration exemption from state and local transaction privilege and use taxes (TPT) on computer equipment and other equipment essential to the operation of the computer equipment. In order to qualify for a 10-year TPT abatement, data centers must make capital investments of at least $50 million over 5 years. In order to qualify for a 20-year TPT abatement, data centers must invest at least $200 million over 5 years. Such qualified data centers are called certified data centers. The program is administered by the Arizona Commerce Authority (ACA). The ACA reported that between 2007 and 2019, certified data centers had invested more than $3.3 billion in qualifying expenditures.[21] The list of companies with qualifying data centers contains 25 names. Businesses may own more than one certified data center. The incentive is scheduled to sunset in 2023.

THE INCENTIVE HELPS ATTRACT DATA CENTERS THAT DO NOT QUALIFY FOR IT

Data centers tend to cluster, with smaller data centers often locating adjacent to larger data centers. One certified data center that is attracted by the incentive can attract other data centers to take advantage of the fiber and power infrastructure established to support the qualifying data center.[22] They also benefit from the entire workforce and supply chain established to support the large data centers. Some of these follow-on data centers will be smaller than the larger data center projects that qualified for the tax incentive and may, themselves, not initially achieve the investment and job creation thresholds required to receive tax benefit from the state. Industry sources estimate that for every Arizona certified data center, there are roughly two data centers in Arizona that are not certified.

In this way, the incentive yields more data center investment than is measured by just counting the data centers that qualify for the incentive. Arizona's data center tax incentive plays an important role in attracting new data centers to the state and in keeping them from moving to other states.

LARGE CAPITAL EXPENDITURES DEPEND ON RENEWAL OF THE INCENTIVE

As noted at the beginning of this report, there appears to be strong evidence that Arizona's data center incentive has contributed to the strong growth of data centers in the state. It is important to keep in mind that potential colocation tenants who are considering where to make a capital investment will want to choose a location where they can confidently predict their tax liability years into the future. Data centers are often expanded over time, so potential tenants will want certainty that they can grow and expand in a chosen location with a favorable tax environment. In the next section we show that data centers have many options when considering favorable tax climates.

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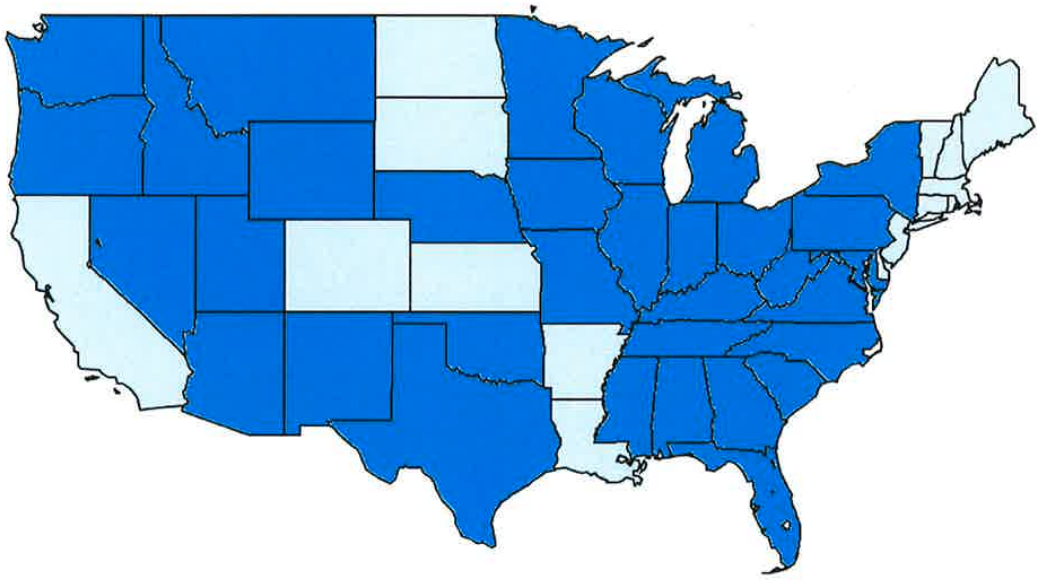
[21] This is the amount of investment reported to the ACA by certified data centers in order to document the minimum investment that they need to make to qualify for the certification. It is not the full amount of investment made by certified data center in Arizona. Arizona's incentive was enacted in 2013, but data centers could qualify with $250 million of investment after 2007.

[22] https://www.datacenterknowledge.com/industry-perspectives/finding-strength-numbers-data-center-clustering-effect

National Context for Arizona Incentives

Arizona is one of 33 states that offer incentives to attract data centers to locate in their states. Figure 8 highlights the states with data center incentives.[23]

Figure 8. States with Data Center Incentives



In 2020, Idaho and Maryland became the latest states to add new data center incentives. Many Maryland legislators saw the enactment of a data center incentive as important for providing sufficient local tax revenue to fund public school reforms. Idaho legislators believed that their state was losing out on rural data center developments even though the state has climate and power cost advantages over other northwestern states.

In June of 2019, Illinois added a new data center incentive.[24] Although the Chicago area is one of the largest data center markets in the United States, it was not keeping pace with the growth of data centers in the markets of Northern Virginia, Dallas, and Phoenix – all located in states that provide incentives to attract data center investment. Additionally, Illinois was failing to attract data centers to the more rural parts of the state, while several large data centers had located across the border in rural Iowa, which has an incentive. The neighboring state of Indiana also strengthened its incentives in June

[23] In addition to the 33 states that have active specific incentives for data centers, four of the other states have tax policies that are beneficial to data centers. Alaska and New Hampshire have no statewide sales tax; Delaware has no state property or sales tax; and Kansas has no state property tax on equipment.

[24] Ally Marotti. "Data center boosters hope new tax incentives 'stop the bleeding,' keep tech sites in Illinois," *Chicago Tribune*, June 2019.

2019 by adding a sales and use tax exemption for data centers to its existing targeted property tax exemption.[25] Developers are hoping to attract data centers to the Indiana suburbs of Chicago.

The competition among states for data centers is significant, and data centers pay close attention to the business climate in various states when making location decisions. States with existing incentives revise and extend them from time to time to make them more attractive. In May of 2018, Georgia expanded its data center tax incentive to include colocation data centers. Days after the governor of Georgia signed the bill into law, the colocation provider Switch announced plans to begin construction on a one million square foot data center campus in Atlanta.[26] Earlier this year, bills were introduced in the Pennsylvania state legislature to expand data center incentives that were enacted in 2016.[27] After Illinois enacted a data center incentive, Indiana revised its data center incentive to lengthen the amount of time that large data centers could receive that state's incentive.[28] In 2016, Virginia extended its tax incentive to 2035 to provide data centers with more certainty and predictability.

NEW JERSEY PROVES TAX CHANGES CHASE AWAY DATA CENTERS

New Jersey is debating adding an incentive. There is a growing realization that the New York-New Jersey region lost its lead in the data center market to Northern Virginia, at least in part because New Jersey is not competitive with other markets on taxes.[29]

An even more dramatic illustration of the sensitivity of data centers to tax changes is the way in which data centers showed their mobility in response to a potential increase in taxes in New Jersey. In the summer of 2020, some elected state officials proposed imposing a 25/100th of one percent or a 1/100th of one percent tax on financial transactions processed in data centers located in New Jersey.[30] In the fall of 2020, the New York Stock Exchange (NYSE) ran its financial transactions out of its data center in Chicago for five days to practice for any possible relocation of the market to data centers out of New Jersey. The Governor of Texas was involved in attempting to attract Nasdaq to data centers in Dallas, the second largest data center market in the United States.

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[25] Dan Carden. "Tax incentives for Hammond data center advance to governor for final approval," *The Times*, April 2019.
[26] Switch. "Georgia Governor Nathan Deal Signs "Switch Bill" Data Center Tax Exemption Legislation."
[27] General Assembly of Pennsylvania, House Bill 1088, Session of 2018.
[28] Alex Brown. "Governor Signs Data Center Incentive Bill," *Inside Indiana Business*, June 2019.
[29] "Twenty years ago, New Jersey probably led the country and data center space, but we haven't moved the needle at all in 20 years." – Gil Santaliz, NJFX "New Jersey was once a hotbed of data center activity, with thriving markets for colocation and financial data centers. The state maintains a substantial and strategically important data center community, but the hottest leasing action has shifted elsewhere, primarily to Northern Virginia." – Data Center Frontier, 1/28/20 "There is a bill being looked at, and it looks very similar to the broad strokes of what you see in Virginia." – Santaliz
[30] Alex Alley, "NYSE and Nasdaq threaten to leave New Jersey if transaction tax goes ahead," datacenterdynamics.com, October 20, 2020.

WASHINGTON STATE HAS PROVEN THE EFFECTIVENESS OF INCENTIVES

Washington State is home to the corporate headquarters of several large tech companies. In 2007, Washington's Attorney General ruled the state's data center incentives invalid. Several companies immediately halted construction on data center facilities in rural Quincy, Washington. One subsequently chose to move its data center operations to Texas. Several large companies also have cited state and local taxes as an important consideration in their decisions to construct new data center facilities in Oregon.

Washington's data center incentives were legislatively re-enacted in 2010, sparking a construction boom and up to $2 billion in new private investment in the state. But, in 2011 the incentives lapsed, which once again halted data center growth in Washington and was associated with $1 billion in new data center investment by Adobe and Apple in Oregon. In 2012, Washington again re-enacted their data center incentives, only to fail to reauthorize them in 2014. At least one major software company cited that lack of reauthorization as a motivating factor in its decision to build a new $1.1 billion data center in Iowa. Washington then re-enacted its data center incentives yet again in July 2015. The current incentive is only available in rural counties. This restriction in Washington has led to a boom in the colocation data center market in the suburbs of Portland, Oregon, just across the border from Washington State.[31] The state is debating revising the incentive again to remove the restriction to rural counties.[32]

DATA CENTER INCENTIVES DO NOT DIMINISH STATE TAX REVENUES

With so many states offering data center incentives, state tax incentives intended to attract data centers do not diminish state tax revenues. This is because data centers can generally find good conditions for their operations in one of the many states that offer data center incentives, and they can avoid states that do not offer incentives. Without the incentives, states will not receive any tax revenue from data centers that locate in other states that have incentives. This is true even in Arizona.

In June of 2019, Virginia's Joint Legislative Audit and Review Commission (JLARC) published an evaluation of the state's data center incentive using confidential tax information that is not publicly available.[33]

JLARC found that 90 percent of the data center investment made by the companies that received the sales and use tax exemption would not have occurred in the state of Virginia without the incentive. Instead, that 90 percent of data center investment would have occurred in states other than Virginia that offer tax incentives. So, the "cost" of the State data center incentive is only 10 percent of the

[31] Washington State Department of Commerce, *State of the Data Center Industry An Analysis of Washington's Competitiveness In This Fast-Growing High-Tech Field*, January 2018.
[32] The Herald Editorial Board. "Editorial: Tax break could bring more data centers to state," *HeraldNet*, March 2018.
[33] Joint Legislative Audit and Review Commission, *Data Center and Manufacturing Incentives, Economic Development Incentives Evaluation Series*. June 17, 2019.

amount of State sales tax revenue exempted. Using the confidential tax information, JLARC estimated the economic and government budgetary impact of Virginia's data center sales and use tax exemption.[34]

Our latest Virginia data center report shows in detail how JLARC determined that in 2017 (the latest year for which data was available at the time) data centers generated $4.7 million more state tax revenue from construction and suppliers than the amount of sales and use tax exempted by Virginia's data center incentive.[35] In 2017, the State took in $1.09 in state tax revenue from data center-related activity for every $1 of potential state tax revenue that was exempted from qualifying data centers.

[34] Appendix N: Results of economic and revenue impact analyses.
[35] Mangum Economics, *The Impact of Data Centers on the State and Local Economies of Virginia, 2020. Also, see Appendix N: Results of Economic and Revenue Impact Analyses.*

Conclusion

Phoenix has a large, rapidly growing data center market. The data center development around the city has fostered the development of a strong tech workforce with rapidly growing employment and wages.

We estimate that in 2020 data centers in Arizona directly provided approximately:

- 2,020 construction jobs,
- $132.4 million in associated construction pay and benefits,
- 530 full-time-equivalent data center operations jobs,
- $42 million in associated data center employee pay and benefits, and
- $539.1 million in economic output from construction and operations combined.

Taking into account the economic ripple effects that direct investment generated, we estimate that the total impact on Arizona from data centers in 2020 was approximately:

- 7,470 jobs (including 80 jobs outside of the Phoenix area),
- $460.2 million in associated employee pay and benefits, and
- $1.5 billion in economic output.

Arizona offers qualifying data centers a transaction privilege and use tax exemption on qualifying equipment as an incentive to encourage data center investment and jobs in the state. Even with this exemption in place, data centers pay millions of dollars in state and local taxes. In addition to the taxes paid directly by data centers, local governments and the State of Arizona collect tax revenue from the secondary indirect economic activity that data centers generate. We estimate that in 2020, data centers directly and indirectly generated a minimum of $85 million in state and local tax revenue in Arizona. This is an underestimate of the true state and local tax revenue associated with the industry because we lack sufficient data to properly estimate several important sources of tax revenue.

At the local level, data centers provide far more in county or city tax revenue than they and their employees demand in local government services. In other markets, data centers have been estimated to generate between $8 and $17 in local tax revenue for every dollar local governments spend on public services for employees and their families. This has enabled local governments to keep residential property taxes up to 20 percent lower than would be the case absent data center revenue.

Data center tax incentives have been shown not to burden state coffers. In June of 2019, Virginia's Joint Legislative Audit and Review Commission found that 90 percent of the data center investment made by the companies that received the sales and use tax exemption would have occurred in other states except for the exemption. In fact, in 2017, the data center tax incentive in Virginia generated $1.09 of State tax revenue for every dollar that it exempted.

Arizona is one of 33 states that offer incentives for data centers that locate and expand in their states. Several states have recently added, enhanced, or renewed their incentives to remain competitive.

About Mangum Economics, LLC

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

- *Potential Impact of the Development of the Offshore Wind Energy Industry on Hampton Roads and Virginia, 2020;*
- *The Potential Impact of a Data Center Incentive in Maryland*, 2020;
- *The Impact of Data Centers on the State and Local Economies of Virginia*, 2016, 2018, and 2020;
- *Opportunities for Southside Virginia to Participate in the Cloud Economy*, 2019;
- *The Economic and Fiscal Contribution that Data Centers Make to Virginia: Spotlight on Prince William County*, 2018; and
- *The Potential Impact of a Data Center Incentive in Illinois*, 2018.

POLICY ANALYSIS

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

ECONOMIC IMPACT ASSESSMENTS AND RETURN ON INVESTMENT ANALYSES

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

CLUSTER ANALYSIS

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

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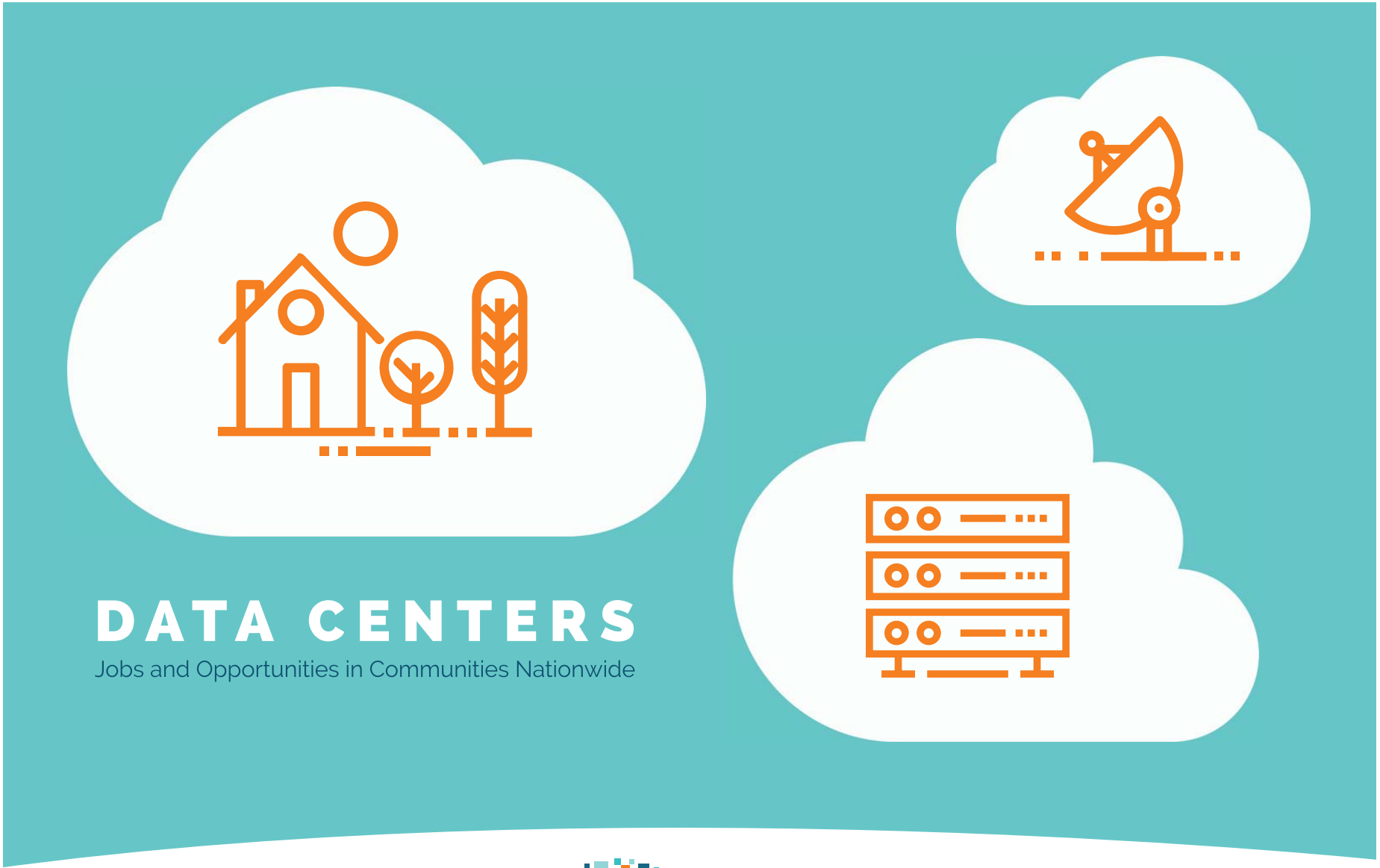


_TEC
U.S. Chamber of Commerce
Technology Engagement Center

REPORT HIGHLIGHTS

Technological innovations are rapidly changing our lives, our businesses, and our economy. Technology, no longer an isolated business sector, is a facilitator enabling innovation, growth, and the strengthening of America's traditional business sectors. From transportation and energy to finance and medicine, businesses rely on technology to interact with their customers, improve their services, and make their operations more globally competitive. Innovative technology is deeply integrated into the economy and is the driving force behind the creation of new jobs in science, health care, education, transportation, and more. Technology has fundamentally transformed our economy—and is poised to fuel even more growth in the future.

Overall, there were 6 million jobs in the U.S. technology industry last year, and we expect this to increase by 4.1% in 2017. Technology-related jobs run the gamut—from transportation logistics and warehousing to programmers and radiologists. In 2012, economists estimated that each high-tech job in the U.S. creates five additional jobs in other local goods and services sectors across all occupations—for example, construction workers, lawyers, dentists, schoolteachers, cooks, and retail clerks.

So what is the backbone that supports the rapid growth of this sector?

Data centers are facilities that house computers that store and process data, anchor our nation's economic growth, bolster job creation, and enable globally competitive innovations.

Burgeoning technologies like drones and sensors, both of which farmers use to monitor their crops and gather key information about their soil and how to increase their yields, are powered by data centers. Lifesaving gene therapies for diseases like cancer and hemophilia are powered by these centers.

Heat sensing drones deployed after natural disasters to locate survivors and deliver lifesaving equipment can arrive at the scene faster than first responders. Wearable technologies that we sport help us lead healthier lifestyles. Distance learning courses empower children and adults to learn new skills or trades to keep up with the constantly evolving job market. Innovations in science, energy, manufacturing, health care, education, transportation and many other fields—and their jobs—are being powered by data centers.

But the benefits of data centers go beyond powering America's cutting-edge innovations. The economic impact, direct and indirect, is substantial.

While being built, a typical data center employs 1,688 local workers, provides $77.7 million in wages for those workers, produces $243.5 million in output along the local economy's supply chain, and generates $9.9 million in revenue for state and local governments. Every year thereafter, that same data center supports 157 local jobs paying $7.8 million in wages, injecting $32.5 million into the local economy, and generating $1.1 million in revenue to state and local governments. And the economic impacts don't stop here.

Opening data centers creates other real, tangible benefits for residents. Data centers directly and indirectly improve local public infrastructure—roads, power lines, water, and sewage systems. They increase the pool of skilled workers and often attract additional centers or partner businesses.

Data centers aren't passive bystanders—they contribute financial and other resources and collaborate with local organizations to support their communities.

With 6 million jobs and 2.5 million job openings, America's technology sector is driving economic growth, expanding global dominance in innovation and entrepreneurship, and putting

Americans to work. Without data centers, we can't power the innovations to keep our economy moving.

That's why the U.S. Chamber Technology Engagement Center (C_TEC) works with hundreds of technology and manufacturing companies on rational policy solutions to drive economic growth and spur innovation to create jobs. To capitalize on the environment for all Americans, our companies need accelerated investment and infrastructure deployment at all levels. Too many regulatory barriers threaten infrastructure improvements.

The tens of thousands of Americans working to build and operate data centers in our local communities are proof that with the right policies and investments, technology will continue to generate jobs and benefits for hardworking families.

Table 1. Initial Capital and Operating Expenditures of a Typical Data center

Net rentable square feet (NRSF)	165,141
Capital expenditure per NRSF	$1,305
Initial capital expenditures	$215.5 M
Land acquisition (6.2%)	$13.4 M
Construction building (20.9%)	$45.0 M
IT equipment (72.9%)	$157.1 M
Annual operating expenditures (8.6% of capital expenditures)	$18.5 M
Power (40.0%)	$7.4 M
Staffing (15.0%)	$2.8 M
Real estate taxes and insurance (5.5%)	$1.0 M
Maintenance, administration, and others (39.5%)	$7.3 M

Table 2. Economic Impacts of a Typical Large Data center to Local Communities

CONSTRUCTION PHASE 18-24 MONTHS	OPERATION PHASE ANNUALLY
1,688 Local Jobs	157 Local Jobs
$77.7 million wages	$7.8 million wages
$243.5 million local economic activities	$32.5 million local andeconomic activities
$9.9 million state & local taxes	$1.1 million state & local taxes

LANDSCAPE OF THE DATA CENTER INDUSTRY

Nam D. Pham, Ph.D.[1] | May 1, 2017

Data centers are facilities containing information technology equipment including servers and networking computers for data processing, data storage, and communications. Large data centers usually consist of shells stacked with racks of servers and IT equipment on a raised floor with power backup and temperature control systems. Many large data centers also have their own power generators for heating and cooling equipment.

Two broad categories of data center ownership are enterprise and colocation. Enterprise, or corporate, data centers are built and owned by large technology companies such as Amazon, Facebook, Google, Microsoft, Yahoo, as well as government agencies, financial institutions, insurance companies, retailers, and other companies across all industries. Enterprise data centers support web-related services for their organizations, partners, and customers. Colocation data centers are typically built, owned, and managed by data center service providers such as Coresite, CyrusOne, Digital Realty Trust, DuPont Fabros, and QTS. These data center service providers do not use the services themselves but rather lease the space to one or multiple tenants. Since third-party data center solutions offer flexibility and scalability of IT needs, many large enterprises operate their own data centers and lease space from data center service providers at the same time. For example, IBM, CenturyLink, and Equinix have their own large data centers and also the largest tenants of Digital Realty Trust. In addition to their own data centers, Microsoft also leases data centers from many different data service providers including Digital Realty Trust, DuPont Fabros, Vantage Data Centers, and CyrusOne.

According to the U.S. Department of Energy, there are 3 million data centers scattered across urban and rural areas in the U.S. More than 90% of the servers are, however, housed in data centers and owned or leased by small- and medium-size businesses. Less than 10% of servers located in large data centers are owned by major cloud providers and national super computer centers.[2]

The Data Center Institute classifies data centers into six size standards, measuring by compute space or rack yield. Compute space is the area, measured in square foot (sf) or square meter (m2), within the data center facility containing server racks and related IT equipment. Rack yield is the number of racks that can fit within a compute space. A rack is normally set to be 25 sf to allow aisle and perimeter space around the server room (Table 3).

As data reliability and privacy become more vital in the digital economy, data centers require uninterruptible power supply systems to minimize the downtime for servers and security systems for their users. Data center infrastructure costs and operational complexities increase with the reliability level. Uptime Institute created a standard Tier Classification System that has four tiers to consistently evaluate the infrastructure performance or uptime of data centers (Table 4).

The number of internet users and the number of applications have been rising exponentially for decades. Commercial users increasingly rely on the internet to provide their services and to store data; noncommercial users access the internet for emailing, texting, streaming videos and music, and social networking through Google, YouTube, Facebook, and Twitter, to name a few. Consequently, more data centers are created to meet the demand of the rising amount of data that is created and stored.

Table 3. Data center Size Classifications[3]

Size Metric	Rack Yield	Compute Space (sf)
Mega	> 9,000	> 225,000
Massive	3,001 - 9,000	75,001 - 225,000
Large	801 - 3,000	20,001 - 75,000
Medium	201 - 800	5,001 - 20,000
Small	11 - 200	251 - 5,000
Mini	1 - 10	1 - 250

Table 4. Data center Infrastructure Tiers[4]

Tier	Description	Uptime	Downtime Per Year
I - Basic Capacity	Data centers provide dedicated site infrastructure to support IT beyond an office setting, including a dedicated space for IT systems, an uninterruptible power supply, dedicated cooling equipment that does not shut down at the end of normal office hours, and an engine generator to protect IT functions from extended power outages.	99.671%	28.8 Hours
II - Redundant Capacity Components	Data centers include redundant critical power and cooling components to provide select maintenance opportunities and an increased margin of safety against IT process disruptions that would result from site infrastructure equipment failures. The redundant components include power and cooling equipment.	99.749%	22 Hours
III - Concurrently Maintainable	Data centers have no shutdowns for equipment replacement and maintenance. A redundant delivery path for power and cooling is added to the redundant critical components of Tier II so that each component needed to support the IT processing environment can be shut down and maintained without impactingthe IT operation.	99.982%	1.6 Hours
IV - Fault Tolerance	Site infrastructure builds on Tier III, adding the concept of Fault Tolerance to the site infrastructure topology. Fault Tolerance means that when individual equipment failures or distribution path interruptions occur, the effects of the events are stopped short of the IT operations.	99.995%	26.3 Minutes

CAPITAL AND OPERATING EXPENDITURES OF DATA CENTERS

Large data centers are capital intensive and require significant investments in time and money to build. Depending on the size and the tier, initial capital investments for large data centers start from several hundreds of millions of dollars and can be over one billion dollars. It is very common that new and larger data centers are added to the same site or campus of the first data center over time. For example, Switch, which designs, constructs, and operates some of the most advanced data centers, has been continuously building and expanding its core Las Vegas Campus. Upon the completion of its Las Vegas 12 data centers, Switch Las Vegas Campus covers nearly 2.4 million square feet with 315 MW capacity of power.

A large up front investment for the initial construction phase includes land purchase, shell construction, and equipment installation. The annual operating costs to run data centers consist of power, staff, taxes, maintenance, and other administration costs. Many cost components such as land prices and taxes vary substantially across states and cities.

CONSTRUCTION PHASE: Three main components of capital expenditures during the initial phase of large data centers are land acquisition, shell construction, and mechanical and electronic equipment purchasing and installation. The construction phase is typically between 18 months and 24 months (Table 5).

Land acquisition: The cost of land includes the property purchase, consultant fees, and brokerage fees. Although the smallest component of a data center's capital expenditures, the cost of land varies substantially across states, counties, and cities. In 2015, CBRE estimated an average cost of land to be 2.5% of total construction and operating costs over 10 years of a typical 5 MW enterprise project across 30 U.S. cities. The CBRE research shows the cost variation from 0.1% of total costs over 10 years in Kansas City, Missouri to 9.9% in Southern California.[5] Other estimates conducted by Uptime Institute and Microsoft range from 0.5% and 2.0% of the initial capital investment.[6]

Base building construction: The base building construction costs include architectural planning and design, building permits, local taxes, land excavation and grading, roadways, tie-ins to utilities, and the building shell. Although less than land prices, construction costs also vary across areas. For example, CBRE estimated that the construction costs of a Tier III 5 MW enterprise project in expensive areas such as Boston and Silicon Valley could be 45% higher than the cost of construction in less expensive areas such as Tulsa and Charlotte. Microsoft Corporation and Forrester Research estimated the cost of a base building shell is approximately 16% of initial capital investment and $200 per sf.[7] The construction costs also increase with the redundancy level of Tier III and Tier IV facilities compared with Tier I and Tier II facilities.[8] Architectural planning and design range between 7.0% (Microsoft) and 25% of the total construction costs (Forrester). The costs of building permits and taxes paid to local governments vary substantially by location. Forrester Research estimated $70 per sf in building permits and taxes paid to local governments.

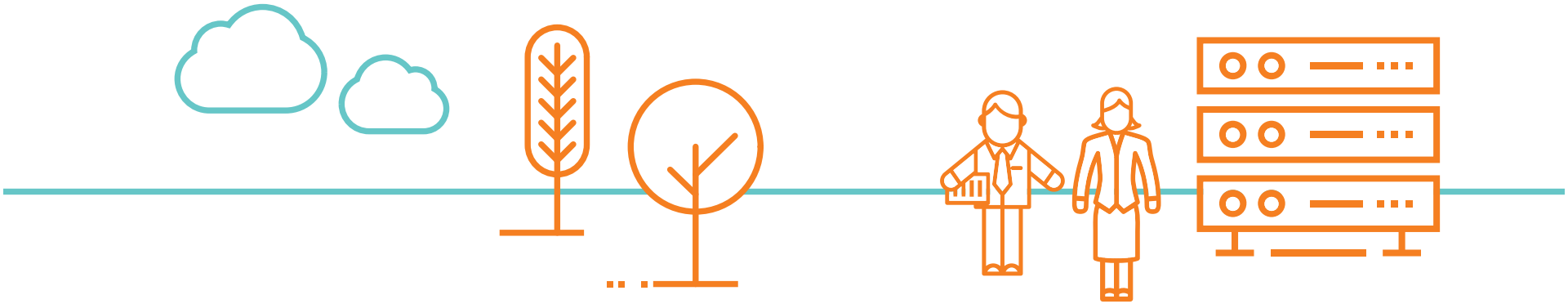
Mechanical and electrical equipment: The costs of data center infrastructure include mechanical and electronic equipment purchases and installation. Mechanical equipment includes computer room air-conditioning units, refrigerant loops, condenser plants or chillers, and water tanks. Electrical equipment includes power distribution units, transformers, patch panels, UPS systems, auto transfer switches, and generators. These costs exclude servers, data storage equipment, and networking devices that are not attached to the building shell. Mechanical and electrical costs range between 82% and 85% of initial capital investment (Microsoft and Uptime Institute).[9] The American Society of Professional Estimators found that electrical equipment costs are approximately 25%, and labor installation costs account for 75% for data centers.[10]

Table 5. Capital Expenditures During the Initial Construction Phase

Land Acquisition	Base Building Construction	Mechanical & Electrical Equipment
Costs include transaction, consultant fees, and brokerage fees. The cost of land acquisition is the smallest cost item but varies substantially across areas. Cost estimates are 2.5% of total project costs over 10 years (CBRE), 2.0% of total cost of data centers (Microsoft), and 0.5% of initial CAPEX (Uptime Institute).	Costs include architectural planning and design, building permits, local taxes, land excavation and grading, roadways, tie-ins to utilities, and base building shell. The cost of the building shell is less varied across regions. Cost estimates are around 16% of initial capital investment and $200 per sf. Costs are rising with higher tier of data centers	Costs include mechanical and electronic equipment and exclude servers, data storage equipment, and networking devices that are not attached to the building shell. Cost estimates are between 82% (Microsoft) and 85% (Uptime Institute) of initial capital investment; the American Society of Professional Estimators estimated electrical equipment accounts for 25% and labor installation accounts for 75% for data centers.

Table 6. Annual Operating Expenditures

Power	Staffing	Taxes	Other
The largest operating item, ranging between 40% and 80% of total annual expenditures.	The second largest operating item, including 24x7x365 security, operations, and IT staff. Staffing expenditures account for 15% of annual operating expenditures.	Property taxes are estimated to be between 8.7% of total cost over 10 years and about 12% of annual operating spending. State and local governments are increasingly providing tax incentives to attract data centers.	Other costs include administrative, maintenance, security, and landscaping. Repairs, replacement, and upgrade of IT equipment and infrastructure begin in year three of operation.



OPERATION PHASE: Annual operating expenditures of a data center are grouped into four main categories: power, staffing, taxes, and other maintenance and administration (Table 6). Estimates of annual operating costs are between 6.0% and 10% of initial capital investment and data centers are typically depreciated over the course of 15 years.[11]

Power: The largest expenditure to operate a data center is power. Typically, half of the power consumption is for running IT equipment (computers and servers) and the other half is for cooling and power infrastructure at data centers.[12] Depending on the data center tier (level of uptime), energy source (traditional versus renewable energy), and region, power expenditures can range from 40% (Uptime Institute) to 80% (Forrester Research) of the overall cost of operating a data center.[13]

Staffing: The second largest expenditure to operate a data center is staffing. Data centers employ security staff, operations staff, and on-site IT engineering and management staff. Most of the positions are 24x7x365 to maintain and operate data centers nonstop. Staffing costs are about 15% of annual expenditures (Uptime Institute) and 4.9% of total costs, including construction, over 10 years (CBRE).[14] DCD Intelligence estimated the data center industry employed 108,500 people in the U.S. in 2015, accounting for 17.5% of global data center employment. It also estimated the proportion of people working on the IT/networks side of the data center industry have increased while those on the facility side have remained steady.[15]

Taxes: A large data center invests hundreds of millions of dollars in capital expenditures in the first couple of years for construction and then continues to spend millions of dollars each year for operations. Data centers generate significant property, sales, and income tax revenues for state and local governments. Uptime Institute estimated that property taxes account for 12.2% of annual operating expenditures of data centers. Similarly, CBRE estimated net taxes of data centers in 30 cities account for 8.7% of the total project cost over 10 years.[16]

Other: Other operating expenditures include maintenance, insurance, security, landscaping, and administration. In addition to ongoing activities, data centers replace, repair, and upgrade to newer and more efficient IT equipment and infrastructure after about three years–and then on an ongoing basis into the future.

INITIAL CAPITAL AND ANNUAL OPERATING EXPENDITURES OF A TYPICAL LARGE DATA CENTER

We use financial data of the most recent development projects and 2016 annual income statements of data center service providers and enterprises to estimate the initial capital and annual operating expenditures of a typical data center. Financial data of data centers are obtained mainly from a company's annual reports filings with the U.S. Securities and Exchange Commission and other publicly available information. The initial capital expenditures include the cost to purchase the land, construct the building shell, and purchase and install mechanical and electrical equipment (IT infrastructure). The annual operating expenditures include power, staffing, taxes, maintenance, and other administrative costs of a data center.

Our data sample includes 244 large colocation and enterprise data centers of the 10 largest data center service providers and enterprises, covering over 40 million net rentable square feet, located across 16 states.[17] The 10 enterprises and service providers in our sample, in alphabetical order, are Apple, CoreSite, CyrusOne, Digital Realty Trust, DuPont Fabros, Facebook, Google, Microsoft, QTS, and Yahoo.

Recent initial capital expenditures on data centers in our sample totaled $8.2 billion and created more than 6.2 million net rentable square feet (NRSF), averaging $1,305 per square foot. The breakdown of initial capital expenditures are 6.2% to acquire the land, 20.9% to build the base building (including planning and design, building permits, local taxes, land excavation and grading, roadways, tie-ins to utilities, and the building shell), and 72.9% to purchase and install mechanical and electrical equipment (including computer room air-conditioning units, refrigerant loop, condenser plant or chiller, and water tank, power distribution units, transformers, patch panels, UPS systems, auto transfer switches, and generators) (Table 7).

Table 7. Initial Capital Expenditure and Operating Expenditure of a Typical Data Center

Net rentable square feet (NRSF)	165,141
Capital Expenditure per NRSF	$1,305
INITIAL CAPITAL EXPENDITURES	**$215.5 M**
Land acquisition (6.2%)	$13.4 M
Construction building (20.9%)	$45.0 M
IT equipment (72.9%)	$157.1 M
ANNUAL OPERATING EXPENDITURES (8.6% OF CAPEX)	**$18.5 M**
Power (40.0%)	$7.4 M
Staffing (15.0%)	$2.8 M
Real estate taxes and insurance (5.5%)	$1.0 M
Maintenance, administration, and others (39.5%)	$7.3 M

Annual operating expenditures accounted for 8.6% of the initial capital expenditures of data centers in our sample. The largest component of annual operating expenditures is power, followed by staffing, taxes, and maintenance. Annual power spending and staffing expenditures are 40.0% and 15.0% of annual spending, respectively. Real estate taxes and insurance expenses are 5.5% and maintenance and all other administrative expenses are 39.5% (Table 7).

ECONOMIC IMPACTS OF A TYPICAL DATA CENTER

Large data centers bring in millions of dollars in initial investment directly to local communities that create ripple effects throughout the surrounding areas. The initial investment directly creates construction jobs to build the data center itself and public infrastructure, including roads, water, sewer, network/fiber, and electrical infrastructure. After being built, data centers operate around the clock, directly creating 24 x 7 x 365 security, operations, and IT jobs. During the construction and operation phases, data centers purchase goods and services from local suppliers and pay wages to their employees, contractors, and vendors. With their earnings, workers spend on housing, food, clothes, education, entertainment, and other daily goods and services. State and local governments generate tax revenues from workers' personal incomes, sales taxes from business activities, and property taxes from individuals and data centers.

We apply regional economic multipliers (RIMS II) constructed and published by the Department of Commerce's Bureau of Economic Analysis (BEA) to calculate the direct, indirect, and induced economic impacts of a data center on local communities. The economic impacts include direct, indirect, and induced effects of the construction and operation of data centers. Direct impacts are changes in economic activity arising from the first round of spending resulting from the initial demand (constructing and operating a data center). Indirect impacts are changes in economic activity resulting from the subsequent rounds of spending by industries along the supply chain affected by the initial demand. Induced impacts are changes in economic activity resulting from the changes in spending by workers whose earnings are affected by the direct and indirect changes.[18]

The economic impact calculations in this study include two phases—the construction phase and the operation phase of data centers. The economic impacts of the construction phase include direct construction jobs and indirect and induced jobs supported by the construction, wages paid to construction workers and indirect and induced workers in the communities, and indirect and induced economic activities supported by the construction. The economic impacts of the operation phase include direct, indirect, and induced jobs supported by the operation of data centers, wages paid to all workers, and all economic activities. We then use average state and local income tax and sales tax rates to estimate tax revenues collected by state and local governments on direct, indirect, and induced jobs and economic activities within the state. Social impacts are real-life monetary and nonmonetary contributions of enterprises to local communities.

Overall, a $215.5 million initial capital investment on building a typical large data center of 165,141 sf supports 1,688 jobs during the 18-24 month construction phase and $77.7 million in wages. After excluding all mechanical and electrical equipment assumed to be produced outside the state, capital investment of the typical data center creates $243.5 million in economic activity for local communities where the data center is located. In addition to property and sales taxes paid directly by the data center, state and local governments generate nearly $9.9 million in income taxes paid by direct, indirect, and induced workers and sales taxes by indirect and induced economic activities (Table 8).

During its yearly operation, a typical large data center supports another 157 local jobs and $7.8 million in wages at the data center and along the supply chain. The data center each year added $32.5 million in additional economic activity to local communities. In addition to property and sales taxes paid directly by the data center, local governments receive an additional $1.1 million per year in individual income and sales taxes (Table 8).

$7.8 MILLION

in annual wages generated by a typical large data center

CONSTRUCTION PHASE: A typical data center, based on our sample of colocation and enterprise data centers, is 165,141 net rentable square feet (NRSF) and requires an initial capital investment of $1,305 per sf, totaling $215.5 million for the initial capital investment. The construction cost breakdowns of our data sample are: 6.2% for land acquisition, 20.9% for the building shell, and 72.9% for mechanical and electrical equipment purchases and installation.

We calculate the construction cost of the shell to be $45.0 million (20.9% of $215.5 million) and the cost of purchasing and installing mechanical and electrical equipment to be $157.1 million (72.9% of $215.5 million). Since mechanical and electrical equipment is most likely purchased from out-of-state vendors and does not produce significant economic impacts within the state where the data center is located, we apply only half of mechanical and electrical equipment spending (i.e., $78.5 million) to represent the installation costs that are spent on local workers. Also, we do not calculate the economic impacts of the land purchase on local economies. Thus, the construction phase of a typical data center creates a $123.5 million construction demand ($45 million for building the shell and $78.5 million for the installation of mechanical and electrical equipment) that affects local economies.

We apply the Bureau of Economic Analysis' (BEA's) regional economic multipliers to calculate the economic impacts of the construction on local economies. The magnitude of economic multipliers varies across regions, depending on the structure of the economy of each individual state. For each additional $1 million spent on a construction project, BEA estimates that between 9 (Delaware) and 17 (Georgia) direct, indirect, and induced jobs are created within a state across all industries along the supply chain. BEA also estimates that an additional $1 million in construction demand creates an additional $0.6 million wages for all direct, indirect, and induced jobs within a state, ranging from $0.5 million in Delaware to $0.8 million in Texas. Last, an additional $1 million in construction demand creates $2.0 million in direct, indirect, and induced output within the state, ranging between $1.6 million in Wyoming and $2.4 million in Texas.

We calculate that $123.5 million investment on construction within the state where the data center is located supports 1,688 direct construction jobs and indirect and induced jobs along the supply chain within the state. These direct, indirect, and induced jobs generate $77.7 million in wages and produce $243.5 million in output within the state. Assuming an average of 5.0% for income state and local tax rates, state and local governments generate $3.9 million income tax revenues from $77.7 million in wages. Since many states offer tax incentive programs, we exclude all direct economic activities of the data center to calculate sales tax generated by state and local governments. Assuming a 5.0% sales tax, state and local governments generate another $6 million from the indirect and induced output within the state. Altogether, state and local governments generate $9.9 million in income and sales taxes during the 18–24 months of the construction period (Table 9).

Table 8. Economic Impacts of a Typical Large Data center to Local Communities

Construction Phase 18-24 months	Operation Phase Annually
1,688 local jobs	157 local jobs
$77.7 million in wages	$7.8 million in wages
$243.5 million in local economic activities	$32.5 million in local economic activities
$9.9 million in state and local taxes	$1.1 million in state and local taxes

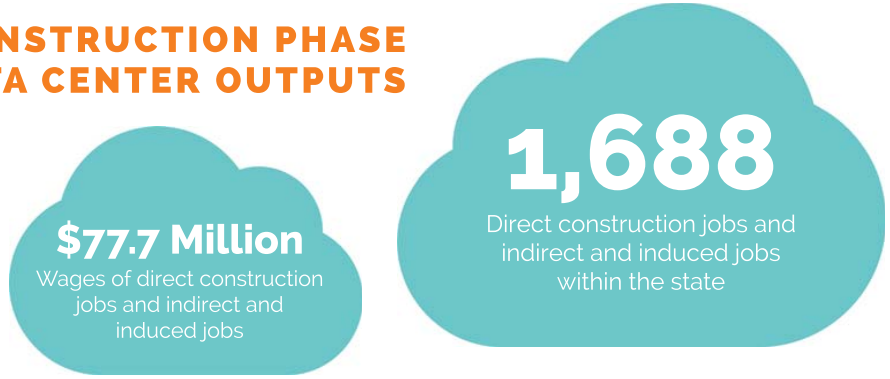
Table 9. Economic Impacts of a Typical Data Center | Construction Phase

Data Center Outputs	Economic Multipliers	Impact
Direct construction jobs and indirect and induced jobs within the state	13.666	1,688
Wages of direct construction jobs and indirect and induced jobs	0.629	$77.7 M
Direct construction outputs and indirect and induced output	1.97	$243.5 M
State and local taxes		$9.9 M
Income taxes of direct, indirect, and induced jobs	5%	$3.9 M
Sales taxes from indirect and induced outputs	5%	$6.0 M

Table 10. Annual Economic Impacts of a Typical Data Center | Operation Phase

Description	Economic Multipliers		Total Impact
Direct, indirect and induced jobs within the state	Power	5.342	157
	Data center	10.659	
Wages of direct, indirect, and induced jobs	Power	0.311	$7.8 M
	Data center	0.503	
Direct, indirect, and induced output	Power	1.574	$32.5 M
	Data center	1.890	
State and local taxes			$1.1 M
Income taxes of direct, indirect, and induced jobs	5%		$0.4 M
Sales taxes from indirect and induced outputs	5%		$0.7 M

CONSTRUCTION PHASE DATA CENTER OUTPUTS



OPERATION PHASE: After being built, data centers have annual expenditures on power, staffing, taxes, maintenance, adminstive costs, and others. Using our data center sample, we estimate that annual operation expenditure accounts for 8.6% of initial capital expenditures. The annual operation expenditures breakdown are 40.0% on power, 15.0% on staffing, 5.5% on real estate tax and insurance, and 39.5% on maintenance, administration, and others.

We calculate annual operating expenditures of a typical large data center to be $18.5 million (8.6% x $215.5 million), of which $7.4 million is spent on power, $2.8 million on staffing, $1.0 million on real estate tax and insurance, and $7.3 million on other maintenance and administration. For the purpose of calculating the annual economic impacts of the data center during the operation phase, we calculate the economic impacts of $7.4 million spending each year on power separately from the rest of the $11.1 million spending on all other maintenance and administration on the data center to account for the increased demand of local utilities.

Similarly, we apply the BEA's regional economic multipliers of the utility industry to calculate the economic impacts of power consumption within a state. For each additional $1 million of spending on power consumption, BEA estimates approximately 5 direct, indirect, and induced jobs are created within a state along the supply chain. BEA also estimates that an additional $1 million in power demand creates $0.3 million wages for all direct, indirect, and induced jobs. Last, an additional $1 million in power demand creates $1.6 million in direct, indirect, and induced output within the state. We then apply the BEA's regional economic multipliers indata processing industry to calculate the economic impacts of the data center spending within a state. For each additional $1 million of spending on data processing, BEA estimates that approximately 10 direct, indirect, and induced jobs are created within a state along the supply chain. BEA also estimates an additional $1 million in data processing demand creates $0.5 million in wages for all direct, indirect, and induced jobs. Finally, an additional $1 million in data processing demand creates $1.9 million in direct, indirect, and induced output within the state.

We calculate that $18.5 million spending on annual operating expenses ($7.4 million on power and $11.1 million on operations) supports 157 direct, indirect, and induced local jobs. These direct, indirect, and induced jobs earn $7.8 million in wages and produce $32.5 million in output. Again, assuming an average of 5.0% for income state and local tax rates, state and local governments generate $0.4 million income tax revenue per year from $7.8 million wages. Since many states offer tax incentive programs, we exclude all direct spending of the data center in our calculations of sales tax generated by state and local governments. Assuming 5.0% sales tax, state and local governments generate another $0.7 million per year from indirect and induced output within the state. Altogether, state and local governments generate $1.1 million income and sales taxes per year during the life of the data center (Table 10).

SPILLOVER BENEFITS TO LOCAL COMMUNITIES

Data centers create positive long-lasting effects on local communities. Building new data centers creates more demand for expanding and upgrading local roads, power, water, and sewage systems. Data centers also spend their own resources to train local workers. These assets remain in the community and benefit other local businesses and residents. With these improvements, data centers attract other data centers and businesses to communities. Like other industries, data centers tend to group together geographically and follow others as seen in Colorado Springs, Raleigh, Des Moines, and other places across the country. In 2017 alone, both Apple and Google have purchased land to build or expand data centers in Nevada. Furthermore, data centers make charitable contributions, partner with local educational institutions, and support local organizations to build stronger communities.

CONTINUOUS ECONOMIC DEVELOPMENT: The development of large data centers tends to happen in stages with ongoing investment in construction to increase capacity. As a result, local economies have additional inflow investments and pipeline projects that promote economic growth. For example, Google in 2016 acquired another 74 acres in Dalles, Oregon, to expand its first corporate data center that was built a decade earlier. The new expansion is estimated to be approximately $600 million, bringing its total investment on data centers in the area to $1.8 billion. Similarly, the Apple and Facebook data centers in Prineville, Oregon, have brought over $1 billion in new investments, which helped the county's economy transition from its dependence on the wood products industry. These projects have created thousands of construction jobs that helped Prineville to reduce unemployment from 20% during the Great Recession to 8%. The diversification of businesses helps lessen local economies' dependence on a particular sector.

ADDING POOL OF TALENTED AND SKILLED WORKERS TO ATTRACT ADDITIONAL BUSINESSES: The availability of related skilled labor such as engineers and construction workers is crucial for high-end and large-scale data centers. The pool of skilled workers in the data center industry, such as building architects and engineers, IT engineers and technicians, and computer system designers, creates advantages for local communities to attract other data centers and other industries as seen in Ohio, Central Washington, and Virginia. Workers trained by Apple and Facebook in Prineville, Oregon, by Google in Dalles, and Dell, Intuit, Microsoft, and Yahoo in Central Washington are valuable assets for these regions.

IMPROVING AND UPGRADING INFRASTRUCTURE: Many data center developments are located in rural areas where public infrastructure is limited. The building of data centers in underdeveloped areas creates a high demand for expansion and the upgrade of public roads, power, water, and sewer systems. In some cases, data centers directly collaborate with local companies to find innovative solutions. These public infrastructure improvements are long lasting and benefit all local businesses and residents.

COMMUNITY IMPACT: Data centers contribute to local communities in different ways, including cash donations, local sponsorships, community grants, STEM education, computer donations, and community assistance. In addition to monetary donations, corporate employees are active volunteers who provide assistance to communities. For example, Google each year works with local organizations to sponsor community events such as Storm the Citadel to promote STEM

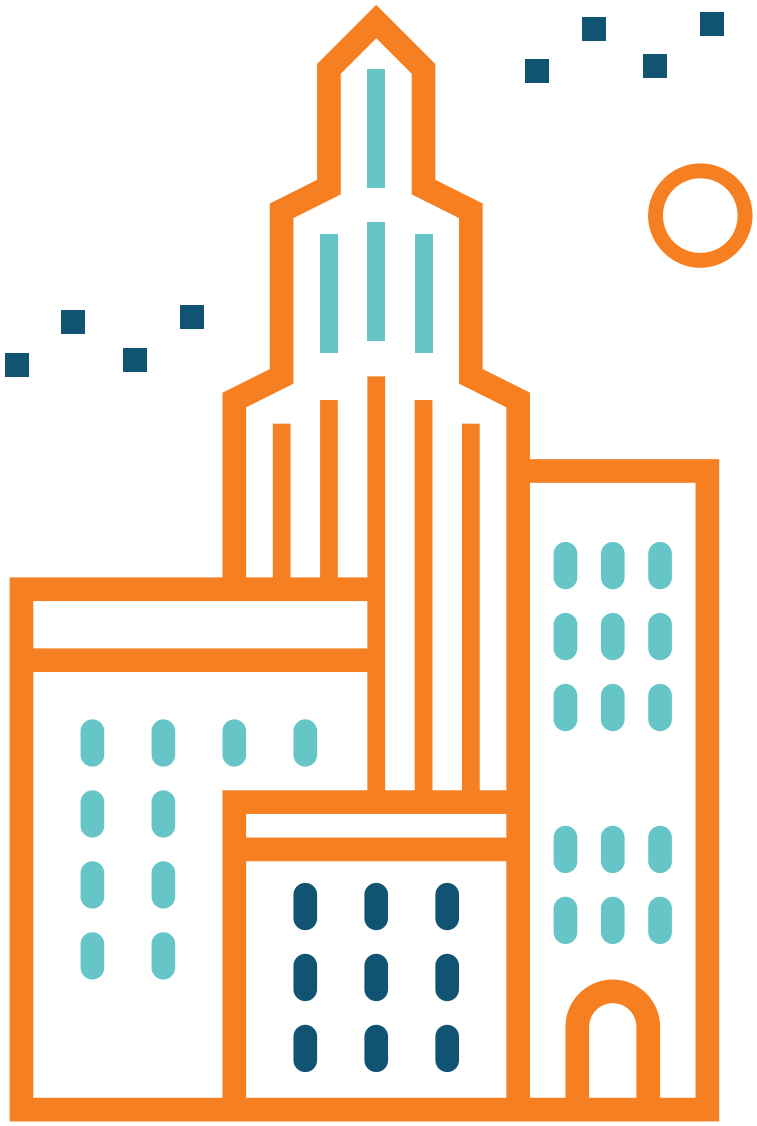
education, Googlefest to help local teachers, nonprofit leaders, and small business owners use the Internet more effectively, and other seminars to help business owners set up and run successful websites. Google has awarded $1.9 million in grants to South Carolina nonprofits and schools.[19] Similarly, Facebook awarded more than $2 million to schools and qualified nonprofits to support STEM education and technological and economic development in communities in which operate data centers,[20] entered into a partnership with Isothermal Community College in North Carolina to develop the curriculum for its Datacenter Institute,[21] and launched a pilot program with the Town of Forest City, North Carolina and Rutherford County Schools to provide free Wi-Fi access to 75–100 students' homes.[22]

INNOVATION: Power is the largest component of data center operating expenditures. Companies are constantly evaluating the source and the cost of power for data centers. Over the past decades, data center owners have been actively involved in clean and renewable energy development by working with local utility and renewable energy companies to develop and purchase power from local wind, solar, and micro-hydro resources. For example, Apple employs an innovative cooling system that reuses water 35 times, resulting in a 20% reduction in overall water consumption in its data center. The data center also uses a rainwater-supplied system for on-site landscape irrigation, further reducing overall water consumption.[23] The Apple campus in Maiden, North Carolina, is supported by renewable energy from two separate 100-acre solar arrays that each produce 42 million kilowatt-hours (kWh) of energy annually.[24] Google contracted many agreements to purchase renewable energy, including the agreement to purchase 407 megawatts of wind-sourced power from MidAmerican Energy Company to supply its data center in Council Bluffs, Iowa. Google sets its goal of powering all its operations with 100% renewable energy. In addition to powering its last seven data centers with renewable energy, Facebook has also begun working with local energy utilities to help create renewable energy tariffs to cover 100% of the anticipated energy consumption for new data centers in Los Lunas, New Mexico, and Papillion, Nebraska. These tariffs are accessible to all companies and Yahoo recently announced the tariff would enable its Nebraska facility to go 100% renewable, as well. Inspired by the model of open source software, the Open Compute Project was launched in 2011 with a mission to share the innovations of IT hardware designs. Since then, the Open Compute Project has become a collaborative community of hundreds of IT and non-IT companies to share specifications and best practices for creating the most energy efficient and economical data centers.

OPPORTUNITIES FOR CITIES

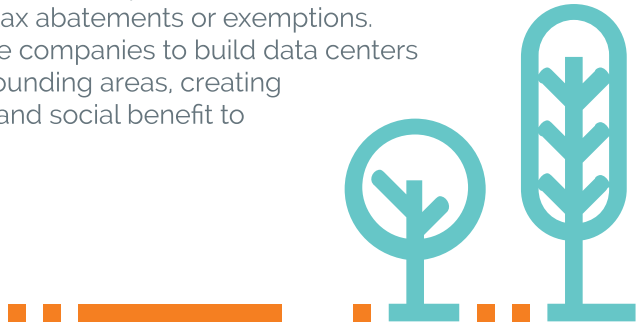
The demand for large data centers is growing because of the demands of increased internet usage and from the migration of smaller to larger data centers. Large businesses are increasingly moving to bigger data centers to achieve cost savings since large data centers experience economies of scale. In its 2016 Cisco Global Cloud Index, Cisco projects that global data center storage capacity will grow nearly 5 times and the number of hyperscale data centers will grow more than 87% from 2015 to 2020.[25]

Enterprises and service providers are constantly searching for reliable, dependable, and cost effective solutions for data center site selection. Factors that affect data center decision makers include the capacity and availability of power, labor, geography, real estate, and costs. Since hundreds of millions of dollars are needed to build and to operate a data center per year, the cost element is crucial.



CONCLUSIONS

Recognizing the short and long-term benefits of data centers to communities, many state and local governments have devoted resources to attract these centers to their areas. Local policymakers have introduced business-friendly policy measures such as sales tax exemption for computing equipment and software, machinery equipment, and computers; infrastructure grants; and property tax abatements or exemptions. These incentives drive companies to build data centers and invest in the surrounding areas, creating significant economic and social benefit to local communities.



APPENDIX

The Date Center Institute Board has endorsed the following terms and definitions.[26]

Standard Term	Definition
Average Measured Peak kW Load	Reported as kW or MW. The average of the measured Peak kW Loads relative to multiple racks and REU or multiple Compute Spaces.
Average Peak kW Load	Reported as kW or MW. New site design: The design target Peak kW Load a Compute Space is designed, or required to support in terms of power and cooling. Existing operational facility: Use the Average Measured Peak kW Load definition.
Compute Space	Reported in Area (sqft or sqm). The area within the data center facility containing racks, REU and associated IT and/or networking equipment. Located within a single facility that shares critical (power and cooling) infrastructure. A campus environment may have more than one Compute Space. Also known as computer area, computer room, data center room, data hall, raised floor area, technical area, and white space.
Data Center	Also spelt data centre and data center. One or more physical rooms or containers accommodating systems and infrastructure that support the operation of IT systems located in one or more IT racks or Rack Equivalent Units.
Design kW Load	Reported as kW or MW. Applies to the maximum kW load the Compute Space is designed to support in terms of power and cooling.
Enterprise Data Centers	Data centers house critical operations of individual companies.
Load	Reported as kW or MW. The actual measured Peak kW Load as reported by an acceptable measurement device or system relative to the REU or Compute Space. The measurement period must exceed 1 calendar month. Partial results and decimal points are to be rounded up to the nearest whole number.
Peak kW Load	Reported as kW or MW. New site design: The design target Peak kW load a Compute Space is designed, or required to support in terms of power and cooling. Existing operational facility: Use the Measured Peak kW Load definition.
Rack Area	Reported in sqft (ft2) or sqm (m2). Sets a common understanding for rack footprint, allowing for aisle space and perimeter and other space within the room area.
Rack Equivalent Unit (REU)	Converts a heterogeneous environment into a standard unit of measure. Also converts non-traditional rack equipment, including free-standing items into an equivalent Rack as used in Rack Area and Rack Yield. A large piece of equipment may use multiple REUs. 1 x REU in spatial terms equals 1 x [Rack Area]
Rack Yield	Reported as quantity of Racks or REUs. Number of Racks (by Rack Area) that can fit within a Compute Space. Rack Yield = [Compute Space] divided by [Rack Area]
Retail Colocation	Building shell and infrastructure in shared environment, space generally divided by racks or cages. May include IT hardware as well as menu of services.
Wholesale Colocation	Building shell and infrastructure to the power distribution unit providing space, power and cooling. Generally in demised suites above 250 kW.

ENDNOTES

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ABOUT US

C_TEC (U.S. Chamber Technology Engagement Center) promotes the role of technology in our economy and advocates for rational policy solutions that drive economic growth, spur innovation, and create jobs.

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Tim Day highlights the role of technology in our economy and advocates for emerging technology. He is responsible for championing rational policy solutions that spur innovation and create jobs. He joined the Chamber from Teradata Corporation. Before Teradata, Day served as vice president of government affairs at NCR Corporation, was chief of staff to Congresswoman Deborah Pryce (R-OH), legislative director to Congressman David Hobson (R-OH), and legislative assistant to Congressman Joe Barton (R-TX). Day earned a B.A. from Cedarville University in Ohio in 1987. He serves on the board of advisors for the Data Coalition, a Washington, D.C.-based coalition that advocates on behalf of the private sector and the public interest for publishing government information as standardized and machine-readable. In 1998, Day was accepted as a delegate to the American Council of Young Political Leaders.

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