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MARYLAND Chamber FOUNDATION

POTENTIAL IMPACT OF LARGE DATA CENTER DEVELOPMENT IN MARYLAND

MANGUM economics

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About Mangum Economic Consulting, LLC

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

- *The Potential Impact of a Data Center Incentive in Illinois*, 2018;
- *The Impact of Data Centers on the State and Local Economies of Virginia*, 2016, 2018, and 2020;
- *The Economic and Fiscal Contribution that Data Centers Make to Virginia: Spotlight on Prince William County*, 2018;
- *Opportunities for Southside Virginia to Participate in the Cloud Economy*, 2019; and
- *The Economic Development Potential of the MAREA and BRUSA Undersea Fiber Optic Cables*, 2017.

POLICY ANALYSIS

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

ECONOMIC IMPACT ASSESSMENTS AND RETURN ON INVESTMENT ANALYSES

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

CLUSTER ANALYSIS

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

The Project Team

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Executive Summary

In this report, we assess the economic and fiscal impact potential if just one large new data center were to locate in Maryland. For illustrative purposes, our analysis focuses on four Maryland Counties – Baltimore, Howard, Kent, and Prince George's. The primary findings from that assessment are:

1) A large data center would provide a very high benefit to cost ratio for these counties in terms of the tax revenue it would generate relative to the government services that it and its employees would require. We estimate that the local benefit to cost ratio would be approximately:

Table 1: Estimated Benefit/Cost Ratio Associated with a Hypothetical Large Data Center for Select Maryland Counties

Locality	Estimated Annual Tax Revenue Benefit	Estimated Annual Budgetary Cost	Benefit/Cost Ratio
Baltimore County	$5,628,000	$193,000	32.9
Howard County	$4,715,000	$223,000	21.2
Kent County	$2,197,000	$165,000	13.3
Prince George's County	$5,587,000	$193,000	29.0

2) A large data center would have a significant one-time economic and fiscal impact on these counties during its construction phase.

Table 2: Summary of One-Time Economic and Fiscal Impacts from Construction of a Hypothetical Large Data Center in Select Maryland Counties

Impact	Baltimore	Howard	Kent	Prince George's
Jobs	1,359	1,210	1,432	1,330
Pay & Benefits	$102,200,000	$111,000,000	$93,300,000	$97,300,000
Economic Output	$227,900,000	$229,400,000	$218,400,000	$218,800,000
County Tax Revenue*	$3,200,000	$3,600,000	$3,500,000	$3,000,000

* Tax revenue estimates exclude sales tax revenue

3) A large data center would have a significant annual economic and fiscal impact on these counties during its on-going operational phase.

Table 3: Summary of Annual Economic and Fiscal Impacts from the On-going Operation of a Hypothetical Large Data Center in Select Maryland Counties

Impact	Baltimore	Howard	Kent	Prince George's
Jobs	121	103	105	107
Pay & Benefits	$8,000,000	$7,500,000	$6,100,000	$6,200,000
Economic Output	$38,500,000	$33,900,000	$32,300,000	$32,700,000
County Tax Revenue*	$5,628,000	$4,715,000	$2,197,000	$5,587,000

* Tax revenue estimates include only real and personal property tax, and energy tax revenue paid directly by the data center.

4) In light of recently proposed educational reforms by the Kirwan Commission that would impose significant additional school funding requirements on localities, the high benefit-to-cost ratio provided by data centers becomes even more salient. Data centers provide a potential economic development opportunity that Maryland localities could use to address these potential additional fiscal burdens.

5) To date, Maryland has not participated in the large and rapid growth of this high-tech industry. States with smaller state economies, have many more data centers than does Maryland, even though Maryland has a larger state economy. And metropolitan statistical areas (MSA) like Austin, Charlotte, Richmond, and San Antonio, with smaller regional economies, have many more data centers than the larger Baltimore-Columbia-Towson MSA.

6) Maryland is one of 19 states that do not actively offer incentives to attract data centers to locate in their states. Because so many states offer 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, Maryland will not receive any tax revenue from data centers that locate in other states that have incentives.

7) In addition to their unusually high local benefit-to-cost ratios, data centers also pay millions of dollars in state taxes, even in states that have sales and use tax exemptions on some data center equipment. As demonstrated by a recent evaluation of Virginia's data center incentive that showed in 2017 Virginia gained $1.09 in state tax revenue from data centers for every $1 of state sales tax revenue exempted.

Introduction to Data Centers

Data centers are the core infrastructure that supports our increasingly digitized lives. Our finances, communications, health care, recreation, entertainment, education, transportation, work, and social lives are often and increasingly online. In recent weeks, the response to corvid 19 virus has brought that growing reality into even sharper focus as we have become even more reliant on our digital infrastructure as a way to remain productive while we socially distance ourselves for public health reasons.

In addition to enabling people to work, communicate, and collaborate remotely, data centers also 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.

Moreover, data centers are more than just passive 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 answers questions about statuses of our bank accounts and internet service.

For these reasons, the need for data centers is growing exponentially. 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 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 dramatic expansion of artificial intelligence, machine learning, and augmented reality are all putting ever-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 – according to a recent analysis by the U.S. Chamber of Commerce spend on average about $7.4 million a year on energy costs[2] – they have

[1] David Greer, "System z Helps Address the Data Analytics Power Crunch," *IBM Systems magazine*, April 2012.
[2] U.S. Chamber Technology Engagement Center, *Data Centers: Jobs and Opportunities in Communities Nationwide*, 2017.

emerged as leading innovators at the forefront of increasing operational efficiency in the use of energy.[3] 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.[4]

Data centers have also emerged as a driving force behind the development of utility scale renewable energy projects in general, and solar projects in particular. Leading data center companies such as Amazon Web Services (AWS), Apple, Facebook, Google, and Microsoft have committed to transitioning to 100 percent sourcing of their power needs from renewable energy providers as a way to reduce their environmental impact. These commitments have translated into long-term-purchase-agreements that provide the financial stability that enables those providers to make the large upfront investments that renewable energy requires. Moreover, data center companies generally prefer to obtain that power from renewable energy sources that are in reasonable proximity of their facilities.

This report quantifies the significant contribution that this dynamic and rapidly evolving industry could make to the state of Maryland and, for illustration, some of its counties. We illustrate the economic and fiscal impact potential if just one large new data center were to locate in Maryland. We describe a hypothetical large data center that is typical of one that might be constructed in Maryland, if Maryland offered incentives for data centers to locate there. We then illustrate the impact of constructing and operating such a data center in four counties in Maryland – Baltimore, Howard, Kent, and Prince George's.

[3] https://www.osti.gov/servlets/purl/1372902/
[4] https://deepmind.com/blog/article/deepmind-ai-reduces-google-data-centre-cooling-bill-40

Methods

The construction and ongoing operation of data centers in Maryland would have large, broad effects across the state economy. To empirically evaluate the statewide and regional economic impact attributable to the data center industry, we employ a commonly-used, regional input-output model called IMPLAN,[5] in combination with characteristics of a hypothetical large data center project.

INPUT-OUTPUT MODELING

Regional input-output 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 Maryland would have 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.

In addition to the economic effects in the Maryland 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 Maryland; 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).

HYPOTHETICAL LARGE DATA CENTER

To model the economic effects of a data center locating in Maryland, we have to define what such a data center project might look like. We have created a hypothetical large data center modeled on the data center described in a report published by the U.S. Chamber of Commerce.[6]

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

[6] U.S. Chamber Technology Engagement Center, *Data Centers: Jobs and Opportunities in Communities Nationwide*, 2017.

The hypothetical large data center that we use in this analysis would require about 20 MW of electrical power capacity and a $215 million investment in construction, exclusive of the cost of the server computing equipment. We assume that $13.4 million is spent on acquisition of 20 acres of land plus the costs of permitting and site preparation; $45.0 million on the construction of the shell of the building; and $156.3 million would be spent for interior construction, cooling and control equipment (plus the installation, customization, and calibration of the equipment). The building would accommodate about 165,000 square feet of compute space. Construction of a data center of this scale would typically take 18 to 24 months.

After construction and preparation are completed, the computer equipment can be installed and operations can begin. For purposes of our analysis, we assume that the data center would operate at 50 percent of server capacity and that would imply an investment of $250 million in server computing equipment. We also assume that the data center would hire 25 direct full-time employees, not counting contractors that provide services such as security and maintenance, and would purchase $7.4 million of electricity annually for about 97 million kWh of power.

Potential Economic and Fiscal Impact in Select Maryland Counties

Using the regional input-output model and information about the hypothetical data center project, we can estimate the economic and fiscal impact of a new data center locating in Maryland. The impact of constructing and operating the same facility in different counties varies because different areas are home to different industries that will indirectly benefit from the new development. The more populated and more economically diverse a county economy is, the more dollars stay in the county, and the larger is the economic impact on the county. In addition, different local tax rates also affect the relative magnitude of the fiscal impact. Therefore, we chose four different counties in Maryland to illustrate the potential impact of the construction and operation of a new data center in those counties. These counties reveal a range of impacts that is likely to be broadly representative of a similar facility being located in another county in Maryland if that were to happen.

In the pages that follow in this section, we report the economic impact in terms of jobs supported, additional worker pay and benefits received, and increased economic activity during both the construction phase of the project and also the operation phase. We also report estimates of the local and state tax revenue that would be generated by the construction and operation of the data center as well as the taxes generated from the other businesses and employees that are part of the data center supply chain.

POTENTIAL ECONOMIC AND FISCAL IMPACT IN BALTIMORE COUNTY, MARYLAND

Baltimore County, Maryland is part of the Baltimore–Columbia–Towson metropolitan statistical area. Operational workforce, connectivity, accessibility, and power would be sufficient to support a large data center in the county.

Construction Phase

By feeding the assumptions detailed in the "Hypothetical Large Data Center" section into the IMPLAN model, we obtain the following estimates of one-time impact from construction. As shown in Table 4, construction of a hypothetical large data center would directly provide a one-time pulse of approximately: 1) 984 jobs, 2) $79.5 million in pay and benefits, and 3) $162.9 million in economic output to Baltimore County.

Taking into account the economic ripple effects that direct impact would generate, we estimate that the one-time impact on Baltimore County would be a total of: 1) 1,359 jobs, 2) $102.2 million in pay and benefits, 3) $227.9 million in economic output, 4) $3.2 million in local fiscal impact (excluding sales tax revenue), and 5) $2.5 million in state fiscal impact (excluding sales tax revenue).

Table 4: Estimated One-Time Economic and Fiscal Impact on Baltimore County from Construction of a Hypothetical Large Data Center (2020 dollars)

Economic Impact	Employment	Labor Income	Output
1st Round Direct Economic Activity	984	$79,500,000	$162,900,000
2nd Round Indirect and Induced Economic Activity	375	$22,700,000	$65,000,000
Total Economic Activity	**1,359**	**$102,200,000**	**$227,900,000**
Fiscal Impact			
Local Tax Revenue			**$3,200,000**
State Tax Revenue			**$2,500,000**

Taking into account the spill-over effects on parts of the state of Maryland outside of Baltimore County, we estimate that the total one-time impact in Maryland outside Baltimore County would be: 1) 47 additional jobs, 2) $3.8 million in pay and benefits, 3) $11.9 million in economic output.

Operations Phase

By again feeding the previously detailed assumptions into the IMPLAN model, we obtain the following estimates of the annual impact once the hypothetical large data center is fully operational. As shown in Table 5, we estimate that on-going operation of the facility would provide a direct annual impact of approximately: 1) 25 full-time jobs, 2) $2.8 million in pay and benefits, and 3) $18.5 million in economic output to Baltimore County.

Taking into account the economic ripple effects that direct impact would generate, we estimate that the annual impact on Baltimore County would be a total of: 1) 121 jobs, 2) $8.0 million in pay and benefits, and 3) $38.5 million in economic output.

Table 5: Estimated Annual Economic Impact on Baltimore County from the On-going Operation of a Hypothetical Large Data Center (2020 dollars)

Economic Impact	Employment	Labor Income	Output
1st Round Direct Economic Activity	25	$2,800,000	$18,500,000
2nd Round Indirect and Induced Economic Activity	96	$5,200,000	$20,000,000
Total Economic Activity	**121**	**$8,000,000**	**$38,500,000**

Taking into account the spill-over effects on parts of the state of Maryland outside of Baltimore County, we estimate that the total on-going impact in Maryland outside Baltimore County would be: 1) 5 additional jobs, 2) $700,000 in pay and benefits, 3) $3.7 million in economic output.

For purposes of our analysis, we assume that the hypothetical large data center would be located in Baltimore County, but outside of any town or other additional taxing jurisdiction within the county. As a result, only county tax rates apply.

During its ongoing operational phase, the hypothetical data center would provide Baltimore County with tax revenue from one primary revenue source – real estate taxes. Based on the previously detailed assumptions and published tax rates, as shown in Table 6 we estimate that the proposed facility would generate $5.6 million in new annual revenue for Baltimore County.

Table 6: Estimated Annual Fiscal Impact on Baltimore County from the On-going Operation of a Hypothetical Large Data Center (2020 dollars)

Revenue Source	Tax Base	Assessment	Tax Rate	Annual Revenue
Real Estate	$215,000,000	100%[7]	$1.10 per $100[8]	$2,365,000
Personal Property	$250,000,000	40%[9]	$2.75 per $100[10]	$2,750,000
Energy	96,732,000 kWh[11]		$0.00530	$513,000
Total Annual Revenue				**$5,628,000**

[7] Data Source: Maryland Department of Assessments and Taxation.

[8] Data Source: Maryland Department of Assessments and Taxation.

[9] Data Source: Maryland Department of Assessments and Taxation. Assumes that personal property would be at the mid-point (*i.e.*, year two) of its depreciation schedule.

[10] Data Source: Maryland Department of Assessments and Taxation.

[11] Calculated as $7.4 million in annual expenditures for electricity divided by $0.0765/KWh (the average industrial electricity rate reported for Maryland by the U.S. Energy Information Agency).

POTENTIAL ECONOMIC AND FISCAL IMPACT IN HOWARD COUNTY, MARYLAND

Howard County, Maryland is part of the Baltimore–Columbia–Towson metropolitan statistical area. Operational workforce, connectivity, accessibility, and power would be sufficient to support a large data center in the county.

Construction Phase

By feeding the assumptions detailed in the "Hypothetical Large Data Center" section into the IMPLAN model, we obtain the following estimates of one-time impact from construction. As shown in Table 7, construction of a hypothetical large data center would directly provide a one-time pulse of approximately: 1) 870 jobs, 2) $88.2 million in pay and benefits, and 3) $162.9 million in economic output to Howard County.

Taking into account the economic ripple effects that direct impact would generate, we estimate that the one-time impact on Howard County would be a total of: 1) 1,210 jobs, 2) $111.0 million in pay and benefits, 3) $229.4 million in economic output, 4) $3.6 million in local fiscal impact (excluding sales tax revenue), and 5) $2.2 million in state fiscal impact (excluding sales tax revenue).

Table 7: Estimated One-Time Economic and Fiscal Impact on Howard County from Construction of a Hypothetical Large Data Center (2020 dollars)

Economic Impact	Employment	Labor Income	Output
1st Round Direct Economic Activity	870	$88,200,000	$162,900,00
2nd Round Indirect and Induced Economic Activity	340	$22,800,000	$66,500,000
Total Economic Activity	**1,210**	**$111,000,000**	**$229,400,000**
Fiscal Impact			
Local Tax Revenue			**$3,600,000**
State Tax Revenue			**$2,200,000**

Taking into account the spill-over effects on parts of the state of Maryland outside of Howard County, we estimate that the total one-time impact in Maryland outside Howard County would be: 1) 20 additional jobs, 2) $1.5 million in pay and benefits, 3) $11.9 million in economic output.

Operations Phase

By again feeding the previously detailed assumptions into the IMPLAN model, we obtain the following estimates of the annual impact once the hypothetical large data center is fully operational. As shown in Table 8, we estimate that on-going operation of the facility would provide a direct annual impact of approximately: 1) 25 full-time jobs, 2) $2.8 million in pay and benefits, and 3) $18.5 million in economic output to Howard County.

Taking into account the economic ripple effects that direct impact would generate, we estimate that the annual impact on Howard County would be a total of: 1) 103 jobs, 2) $7.5 million in pay and benefits, and 3) $33.9 million in economic output.

Table 8: Estimated Annual Economic Impact on Howard County from the On-going Operation of a Hypothetical Large Data Center (2020 dollars)

Economic Impact	Employment	Labor Income	Output
1st Round Direct Economic Activity	25	$2,800,000	$18,500,000
2nd Round Indirect and Induced Economic Activity	78	$4,700,000	$15,400,000
Total Economic Activity	**103**	**$7,500,000**	**$33,900,000**

Taking into account the spill-over effects on parts of the state of Maryland outside of Howard County, we estimate that the total on-going impact in Maryland outside Howard County would be: 1) $100,000 in pay and benefits, and 2) $500,000 in economic output.

For purposes of our analysis, we assume that the hypothetical large data center would be located in Howard County, but outside of any town or other additional taxing jurisdiction within the county. As a result, only county tax rates apply.

During its ongoing operational phase, the hypothetical data center would provide Howard County with tax revenue from one primary revenue source – real estate taxes. Based on the previously detailed assumptions and published tax rates, as shown in Table 9 we estimate that the proposed facility would generate $4.7 million in new annual revenue for Howard County.

Table 9: Estimated Annual Fiscal Impact on Howard County from the On-going Operation of a Hypothetical Large Data Center (2020 dollars)

Revenue Source	Tax Base	Assessment	Tax Rate	Annual Revenue
Real Estate	$215,000,000	100%[12]	$1.01 per $100[13]	$2,180,000
Personal Property	$250,000,000	40%[14]	$2.54 per $100[15]	$2,535,000
Total Annual Revenue				**$4,715,000**

[12] Data Source: Maryland Department of Assessments and Taxation.

[13] Data Source: Maryland Department of Assessments and Taxation.

[14] Data Source: Maryland Department of Assessments and Taxation. Assumes that personal property would be at the mid-point (*i.e.*, year two) of its depreciation schedule.

[15] Data Source: Maryland Department of Assessments and Taxation.

POTENTIAL ECONOMIC AND FISCAL IMPACT IN KENT COUNTY, MARYLAND

Kent County, Maryland is located near the top of the Eastern Shore of Maryland. It is not part of any of the metropolitan statistical areas that cover other parts of the state. Because of its smaller population, a data center in Kent County would need to draw from surrounding areas for its operational workforce. It is also likely that upgrades would be needed for connectivity and power to support a large data center in the county. Although the economic and fiscal impact from a hypothetical large data center would likely spill over onto surrounding areas, our estimates only address the impact on Kent County specifically.

Construction Phase

By feeding the assumptions detailed in the "Hypothetical Large Data Center" section into the IMPLAN model, we obtain the following estimates of one-time impact from construction. As shown in Table 10, construction of a hypothetical large data center would directly provide a one-time pulse of approximately: 1) 1,070 jobs, 2) $76.2 million in pay and benefits, and 3) $162.9 million in economic output to Kent County.

Taking into account the economic ripple effects that direct impact would generate, we estimate that the one-time impact on Kent County would be a total of: 1) 1,432 jobs, 2) $93.3 million in pay and benefits, 3) $218.4 million in economic output, 4) $3.5 million in local fiscal impact, and 5) $2.6 million in state fiscal impact.

Table 10: Estimated One-Time Economic and Fiscal Impact on Kent County from Construction of a Hypothetical Large Data Center (2020 dollars)

Economic Impact	Employment	Labor Income	Output
1st Round Direct Economic Activity	1,070	$76,200,000	$162,900,000
2nd Round Indirect and Induced Economic Activity	362	$17,100,000	$55,500,000
Total Economic Activity	**1,432**	**$93,300,000**	**$218,400,000**
Fiscal Impact			
Local Tax Revenue			**$3,500,000**
State Tax Revenue			**$2,600,000**

Taking into account the spill-over effects on parts of the state of Maryland outside of Kent County, we estimate that the total one-time impact in Maryland outside Kent County would be: 1) 58 additional jobs, 2) $4.5 million in pay and benefits, 3) $13.0 million in economic output.

Operations Phase

By again feeding the previously detailed assumptions into the IMPLAN model, we obtain the following estimates of the annual impact once the hypothetical large data center is fully operational. As shown in Table 11, we estimate that on-going operation of the facility would provide a direct annual impact of

approximately: 1) 25 full-time jobs, 2) $2.8 million in pay and benefits, and 3) $18.5 million in economic output to Kent County.

Taking into account the economic ripple effects that direct impact would generate, we estimate that the annual impact on Kent County would be a total of: 1) 105 jobs, 2) $6.1 million in pay and benefits, and 3) $32.3 million in economic output.

Table 11: Estimated Annual Economic Impact on Kent County from the On-going Operation of a Hypothetical Large Data Center (2020 dollars)

Economic Impact	Employment	Labor Income	Output
1st Round Direct Economic Activity	25	$2,800,000	$18,500,000
2nd Round Indirect and Induced Economic Activity	80	$3,300,000	$13,800,000
Total Economic Activity	**105**	**$6,100,000**	**$32,300,000**

Taking into account the spill-over effects on parts of the state of Maryland outside of Kent County, we estimate that the on-going impact in Maryland outside Kent County would be: 1) $500,000 in pay and benefits and 2) $3 million in economic output.

For purposes of our analysis, we assume that the hypothetical large data center would be located in Kent County, but outside of any town or other additional taxing jurisdiction within the county. As a result, only county tax rates apply.

During its ongoing operational phase, the hypothetical data center would provide Kent County with tax revenue from one primary revenue source – real estate taxes. Based on the previously detailed assumptions and published tax rates, as shown in Table 12 we estimate that the proposed facility would generate $2.2 million in new annual revenue for Kent County.

Table 12: Estimated Annual Fiscal Impact on Kent County from the On-going Operation of a Hypothetical Large Data Center (2020 dollars)

Revenue Source	Tax Base	Assessment	Tax Rate	Annual Revenue
Real Estate	$215,000,000	100%[16]	$1.022 per $100[17]	$2,197,300
Total Annual Revenue				**$2,197,300**

[16] Data Source: Maryland Department of Assessments and Taxation.

[17] Data Source: Maryland Department of Assessments and Taxation.

POTENTIAL ECONOMIC AND FISCAL IMPACT IN PRINCE GEORGE'S COUNTY, MD

Prince George's County, Maryland borders the eastern side of the District of Columbia and is part of the Washington-Arlington-Alexandria, DC-VA-MD-WV metropolitan statistical area. Operational workforce, connectivity, accessibility, and power would be sufficient to support a large data center in the county.

Construction Phase

By feeding the assumptions detailed in the "Hypothetical Large Data Center" section into the IMPLAN model, we obtain the following estimates of one-time impact from construction. As shown in Table 13, construction of a hypothetical large data center would directly provide a one-time pulse of approximately: 1) 990 jobs, 2) $79.7 million in pay and benefits, and 3) $162.9 million in economic output to Prince George's County.

Taking into account the economic ripple effects that direct impact would generate, we estimate that the one-time impact on Prince George's County would be a total of: 1) 1,330 jobs, 2) $97.3 million in pay and benefits, 3) $218.8 million in economic output, 4) $3.0 million in local fiscal impact, and 5) $2.0 million in state fiscal impact.

Table 13: Estimated One-Time Economic and Fiscal Impact on Prince George's County from Construction of a Hypothetical Large Data Center (2020 dollars)

Economic Impact	Employment	Labor Income	Output
1st Round Direct Economic Activity	990	$79,700,000	$162,900,000
2nd Round Indirect and Induced Economic Activity	350	$17,600,000	$55,900,000
Total Economic Activity	**1,330**	**$97,300,000**	**$218,800,000**
Fiscal Impact			
Local Tax Revenue			**$3,000,000**
State Tax Revenue			**$2,000,000**

Taking into account the spill-over effects on parts of the state of Maryland outside of Prince George's County, we estimate that the total one-time impact in Maryland outside Prince George's County would be: 1) 20 additional jobs, 2) $1.3 million in pay and benefits, 3) $5.9 million in economic output.

Operations Phase

By again feeding the previously detailed assumptions into the IMPLAN model, we obtain the following estimates of the annual impact once the hypothetical large data center is fully operational. As shown in Table 14, we estimate that on-going operation of the facility would provide a direct annual impact of approximately: 1) 25 full-time jobs, 2) $2.8 million in pay and benefits, and 3) $18.5 million in economic output to Prince George's County.

Taking into account the economic ripple effects that direct impact would generate, we estimate that the annual impact on Prince George's County would be a total of: 1) 107 jobs, 2) $6.2 million in pay and benefits, and 3) $32.7 million in economic output.

Table 14: Estimated Annual Economic Impact on Prince George's County from the On-going Operation of a Hypothetical Large Data Center (2020 dollars)

Economic Impact	Employment	Labor Income	Output
1st Round Direct Economic Activity	25	$2,800,000	$18,500,000
2nd Round Indirect and Induced Economic Activity	82	$3,400,000	$14,200,000
Total Economic Activity	**107**	**$6,200,000**	**$32,700,000**

Taking into account the spill-over effects on parts of the state of Maryland outside of Prince George's County, we estimate that the on-going impact in Maryland outside Prince George's County would be: 1) $100,000 in pay and benefits and 2) $400,000 in economic output.

For purposes of our analysis, we assume that the hypothetical large data center would be located in Prince George's County, but outside of any town or other additional taxing jurisdiction within the county. As a result, only county tax rates apply. During its ongoing operational phase, the hypothetical data center would provide Prince George's County with tax revenue from three primary revenue sources – real estate tax, personal property tax, and an energy tax on electricity consumption. Based on the previously detailed assumptions and published tax rates, as shown in Table 15 we estimate that the proposed facility would generate $5.6 million in new annual revenue for Prince George's County.

Table 15: Estimated Annual Fiscal Impact on Prince George's County from the On-going Operation of a Hypothetical Large Data Center (2020 dollars)

Revenue Source	Tax Base	Assessment	Tax Rate	Annual Revenue
Real Estate	$215,000,000	100%[18]	$1.00 per $100[19]	$2,150,000
Personal Property	$250,000,000	40%[20]	$2.50 per $100[21]	$2,500,000
Energy	96,732,000 kWh[22]		$0.00969	$937,000
Total Annual Revenue				**$5,587,000**

[18] Data Source: Maryland Department of Assessments and Taxation.

[19] Data Source: Maryland Department of Assessments and Taxation.

[20] Data Source: Maryland Department of Assessments and Taxation. Assumes that personal property would be at the mid-point (*i.e.*, year two) of its depreciation schedule.

[21] Data Source: Maryland Department of Assessments and Taxation.

[22] Calculated as $7.4 million in annual expenditures for electricity divided by $0.0765/KWh (the average industrial electricity rate reported for Maryland by the U.S. Energy Information Agency).

Local Government Benefit to Cost Ratios Associated with Data Centers

Typically, the largest source of local revenue for a county is property taxes, while the largest source of local expenditures is education. As a result, because the data centers need more equipment than they need employees, they provide a high benefit to cost ratio to localities in terms of the tax revenue they generate relative to the government services that they and their employees require.

ANALYSIS FOR SELECT MARYLAND COUNTIES

In this portion of the section, we estimate what the benefit to cost ratio would be for Baltimore, Howard, Kent, and Prince George's Counties from a hypothetical large data center. To quantify the budgetary cost that a hypothetical large data center would impose on these counties, we use data from the Maryland Department of Legislative Services on local government finances, in combination with data from the Maryland Department of Education, U.S. Census Bureau, and U.S. Bureau of Labor Statistics to compute the per-employee cost of educational and non-educational county services for data center employees. 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 16 details the calculations used to estimate the annual budgetary cost that a hypothetical large data center would impose on each of these four counties. As shown, we estimate those costs to be approximately $171,000 in Baltimore County, $223,000 in Howard County, $165,000 in Kent County, and $193,000 in Prince George's County.

Table 16: Estimated Annual County Service Costs Imposed by Hypothetical Large Data Center Employees

	Baltimore County	Howard County	Kent County	Prince George's County
Direct Data Center Employment	25	25	25	25
Students per Employee[23]	0.29	0.33	0.23	0.40
Per Student County Contribution to K-12 Education Expenditures[24]	$8,698	$11,115	$9,760	$6,434
Total Education Costs[25]	**$62,807**	**$91,247**	**$54,947**	**$64,013**
County Residents per Employee[26]	2.18	1.88	2.42	2.84
Per Resident Non-Education County Expenditures[27]	$1,985	$2,807	$1,823	$1,812
Total Non-Education Costs[28]	**$108,044**	**$131,639**	**$110,492**	**$128,578**
TOTAL COSTS	**$170,851**	**$222,886**	**$165,439**	**$192,592**

As shown in Table 17, combining the estimates of budgetary cost from Table 16 with data from Tables 6, 9, 12, and 15 on the estimated local revenue that would be generated by a hypothetical large data center shows that the local benefit to cost ratio would be:

- 32.9 in Baltimore County. This means that for every $1.00 in county expenditures that the hypothetical large data center was responsible for generating, it would provide approximately $32.90 in tax revenue.
- 21.2 in Howard County. This means that for every $1.00 in county expenditures that the hypothetical large data center was responsible for generating, it would provide approximately $21.20 in tax revenue.

[23] Data Source: Maryland Department of Education and U.S. Bureau of Labor Statistics. Derived by dividing total county K-12 school enrollment in 2018 by total county employment in 2018.

[24] Data Source: Maryland Department of Legislative Services, "Local Government Finances in Maryland," 2019, and Maryland Department of Education. Derived by dividing total county contribution to K-12 educational expenditures in 2018 by total county K-12 school enrollment in 2018.

[25] Calculated as data center employment, times students per employee, times per student local contribution to K-12 education expenditures.

[26] 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.

[27] Data Source: Maryland Department of Legislative Services, "Local Government Finances in Maryland," 2019, and U.S. Census Bureau. Derived by dividing total county non-educational expenditures in 2018 by total county population in 2018.

[28] Calculated as data center employment, times county residents per employee, times per resident non-education expenditures.

- 13.3 in Kent County. This means that for every $1.00 in county expenditures that the hypothetical large data center was responsible for generating, it would provide approximately $13.30 in tax revenue.
- 29.0 in Prince George's County. This means that for every $1.00 in county expenditures that the hypothetical large data center was responsible for generating, it would provide approximately $29.00 in tax revenue.

Table 17: Estimated Benefit/Cost Ratio Associated with a Hypothetical Large Data Center

Locality	Estimated Tax Revenue Benefit	Estimated Budgetary Cost	Benefit/Cost Ratio
Baltimore County	$5,628,000	$171,000	32.9
Howard County	$4,715,000	$223,000	21.2
Kent County	$2,197,000	$165,000	13.3
Prince George's County	$5,587,000	$193,000	29.0

LOCAL REVENUE IN THE CONTEXT OF KIRWAN COMMISSION RECOMMENDATIONS

The Maryland Commission on Innovation and Excellence in Education, frequently referred to as the Kirwan Commission, was created in 2016 and tasked with developing major reforms to improve the quality of Maryland's public education system. In October of 2019, the Commission voted on and submitted its recommendations. Those recommendations addressed five major policy areas: 1) early childhood education, 2) high quality and diverse teachers and leaders, 3) college and career readiness, 4) more resources for students that need them, and 5) accountability.

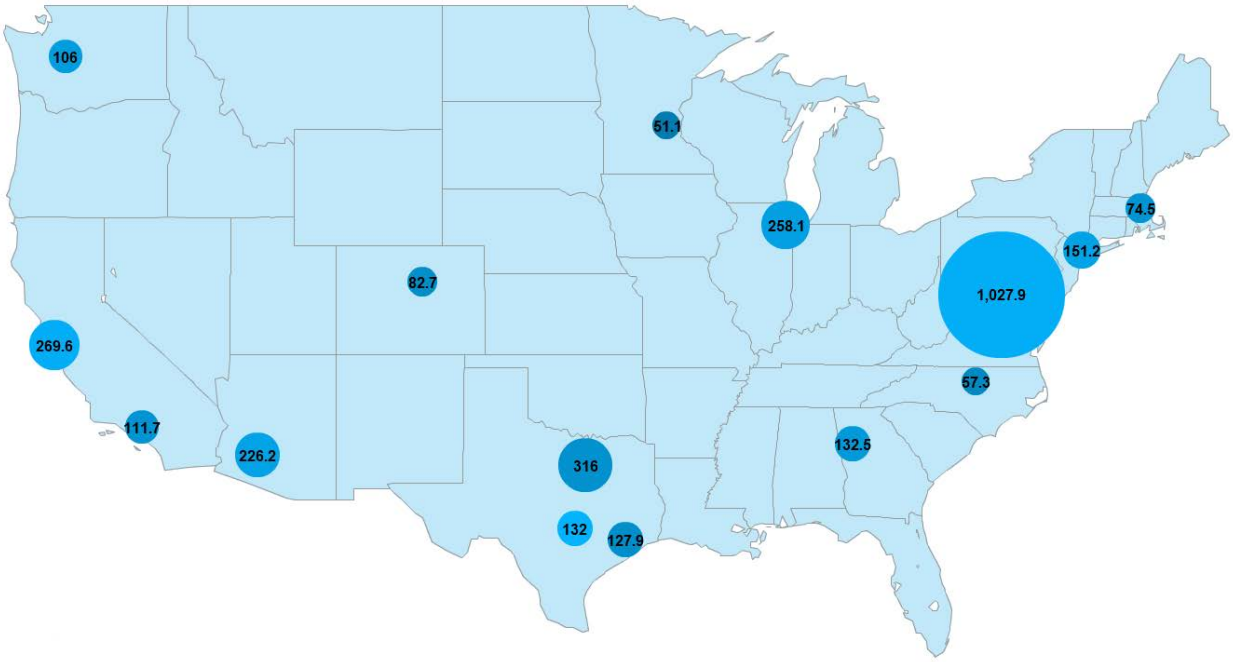
The Commission estimated the additional funding required to implement those recommendations in fiscal year 2030 alone would be $3.8 billion, with approximately $1.1 billion of that total coming from local government. However as HB 1300, the primary legislative vehicle for the proposed reforms, has moved through the 2020 Maryland General Assembly it has been heavily amended. And a March 16 estimate by the Maryland Department of Legislative Services pegged the FY 2030 local funding required by HB 1300 with Senate amendments at $601.1 million. But even that reduced estimate indicates that heavy additional fiscal burdens would be placed on certain localities. For example, the City of Baltimore would be required to provide $152.2 million in additional local funding in FY 2030, Montgomery County $147.9 million, Prince George's County $141.9 million, and Baltimore County $63.2 million.

In light of the increased demand for local funding of schools, the high benefit-to-cost ratio provided by data centers becomes even more salient. Data centers provide a potential economic development opportunity that Maryland localities could use to address the potential additional fiscal burdens expected by the education reform proposals.

The U.S. Data Center Landscape

Figure 1 shows the top 15 largest data center markets in the United States in 2019. 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[29]



The data center industry has been in a rapid growth phase, and it will continue to be for the foreseeable future. The way that the map looked in 2019, is very different from how it looked only a decade ago. And the map could look very different ten years from now.

To illustrate this, 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."[30] 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."

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

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 added in the same period.[31] 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.

Moreover, because of the limitations of publicly-available information, the map in Figure 1 does not show data center facilities that are wholly used by one client. In general, such "enterprise, hyper-scale" data centers belong to giant, high-tech companies that are household names. These companies have constructed a large number of data centers in states like Iowa and Ohio, states that are not in the top 15 markets in the country for data centers that are available to serve multiple clients.

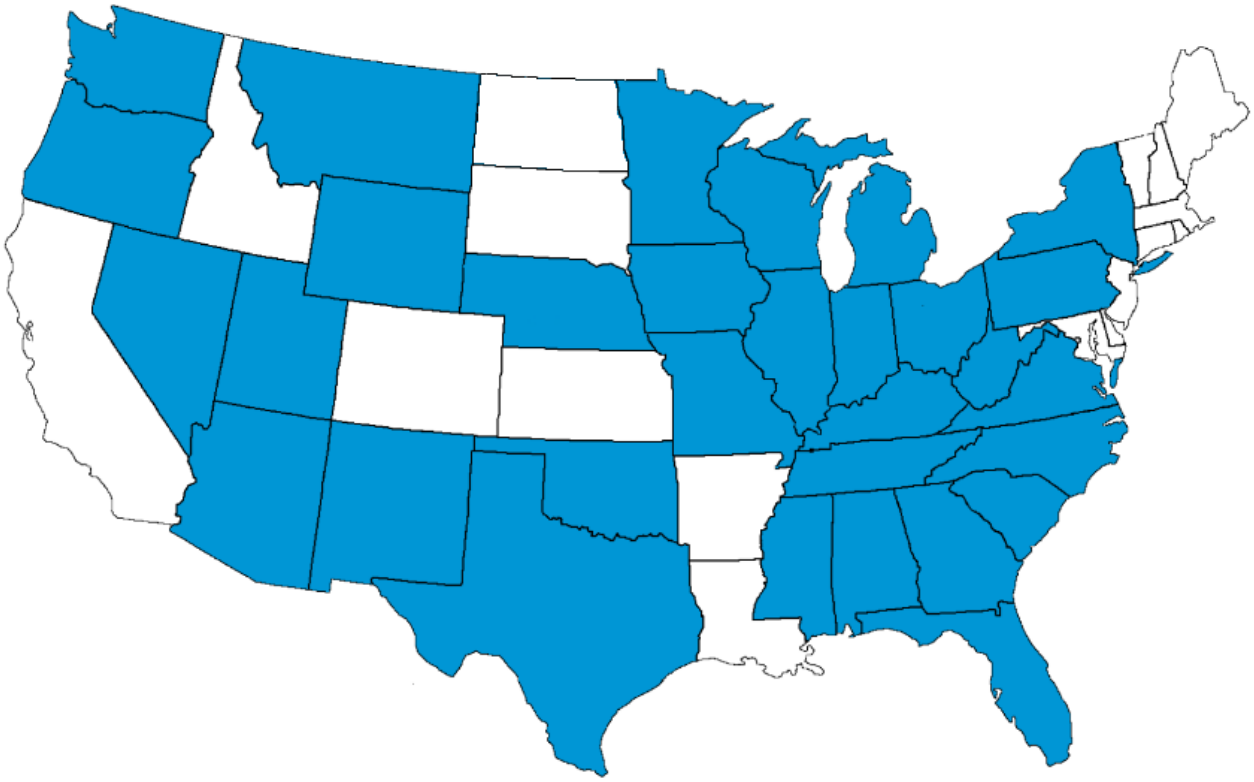
To date, Maryland has not participated in the large and rapid growth of this high-tech industry. States like Arizona, Iowa, and Ohio, with smaller state economies, have many more data centers than does Maryland, even though Maryland has a larger state economy. And metropolitan statistical areas (MSA) like Austin, Charlotte, Richmond, and San Antonio, with smaller regional economies, have many more data centers than the larger Baltimore-Columbia-Towson MSA. One important reason for this is that most other states offer tax incentives for data center equipment, while Maryland does not.

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

National Context for Data Center Incentives

Maryland is one of 19 states that do not actively offer incentives to attract data centers to locate in their states. Figure 2 highlights the states with active data center incentives.[32]

Figure 2. States with Active Data Center Incentives



In June of 2019, Illinois became the latest state to add a new data center incentive.[33] 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

[32] 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.

[33] 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.[34] 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.[35] In 2019, bills were introduced in the Pennsylvania state legislature to expand data center incentives that were enacted in 2016.[36] 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.[37]

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.[38] The state is debating revising the incentive again to remove the restriction to rural counties.[39]

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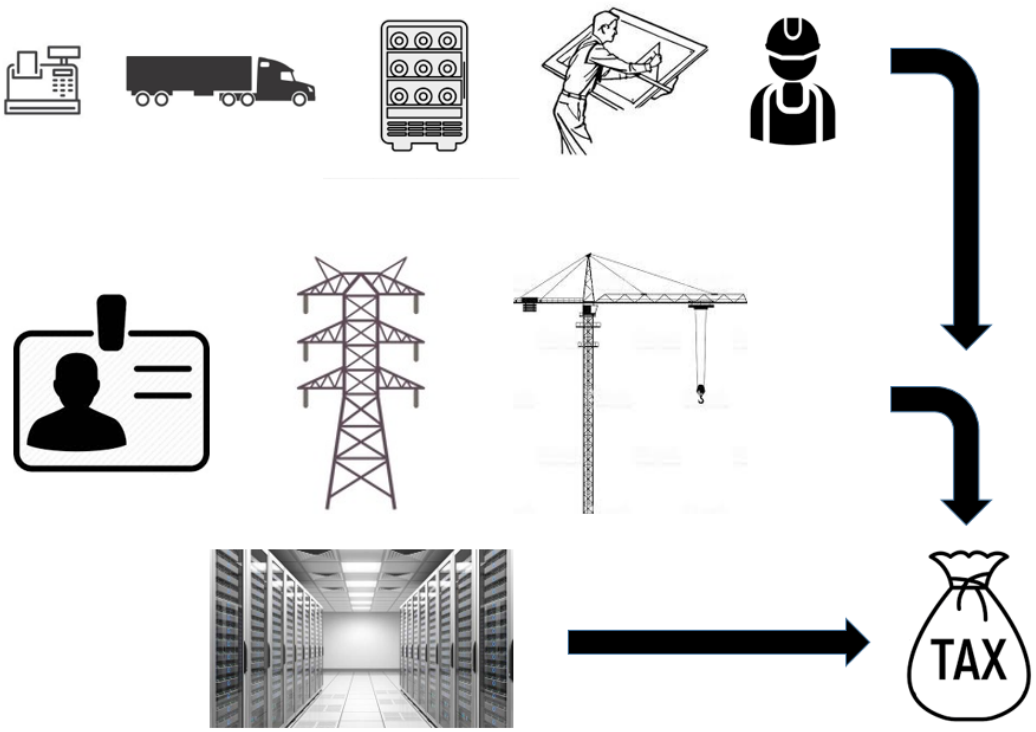
[34] Dan Carden. "Tax incentives for Hammond data center advance to governor for final approval," *The Times*, April 2019.
[35] Switch. "Georgia Governor Nathan Deal Signs "Switch Bill" Data Center Tax Exemption Legislation."
[36] General Assembly of Pennsylvania, House Bill 1088, Session of 2018.
[37] Alex Brown. "Governor Signs Data Center Incentive Bill," *Inside Indiana Business*, June 2019.
[38] 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.
[39] Washington Economic Development Association. 2020 Legislative Agenda.

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 and corporate income tax. At the local level, they also pay real estate taxes, tangible personal property taxes, business license taxes, and industrial utilities taxes.

In addition to the taxes that data centers pay directly, the economic activity that they generate also results in additional tax collections. Figure 3 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 3. Sources of Tax Revenue Associated with Data Centers



DATA CENTER INCENTIVES DO NOT DIMINISH STATE TAX REVENUES

Because so many states offer 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 Virginia.

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.[40] A key finding of that evaluation was that 90 percent of the data center investment made by companies that received the sales and use tax exemption would not have occurred in Virginia without the incentive. Instead, that 90 percent of data center investment would have gone to other states that offer tax incentives. This means the "cost" of Virginia's data center incentive is only 10 percent of the amount of state sales tax revenue exempted.

Using the confidential tax information, JLARC also estimated the economic and government budgetary impact of Virginia's data center sales and use tax exemption for fiscal years 2013 through 2017 (the most recently available for the period since 2012 when the Virginia General Assembly made significant revisions to the state's data center incentive).[41] Table 18 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.

[40] Joint Legislative Audit and Review Commission, *Data Center and Manufacturing Incentives, Economic Development Incentives Evaluation Series*. June 17, 2019.
[41] Appendix N: Results of economic and revenue impact analyses.

Table 18. Economic and Tax Impacts of Virginia's Sales and Use Tax Exemption for Data Centers[42]

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.

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.[43]

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

[43] 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.

Conclusion

Our analysis has shown that the construction of a large data center in Maryland would provide work for over a thousand construction workers, while its subsequent operation would support over 100 jobs and provide millions of dollars in local pay and benefits. In addition, because data centers generate significant local tax revenue while imposing few costs on local services they provide an unusually high local benefit-to-cost ratio. More specifically, our estimate of the likely local benefit-cost-ratio in the four counties considered in this report ranged from 13-to-1 to almost 33-to-1. Which means that a data center in these counties would return $13 to $33 in local tax revenue for every $1 it or its employees consumed in local government services.

At the state level, Maryland has not participated in the large and rapid growth of the data center industry. Maryland is also one of 19 states that currently do not actively offer incentives to attract data centers. Because of this highly competitive environment, the availability or the lack of data center incentives can have a significant impact on data center location decisions. As an example, a recent evaluation of Virginia's data center incentive by the Joint Legislative Audit and Review Commission (JLARC) found that 90 percent of the investment made by data center companies that received the state's sales and use tax exemption would not have come to Virginia without the incentive. As a result, it is important to realize that incentives, which simply reduce a portion of the tax burden imposed on an industry, do not represent a "cost" to state government because they are a reduction of revenues that would otherwise not be forthcoming if data centers choose to locate in other more competitively attractive states.

It is also important to realize that, in addition to their unusually high local benefit-to-cost ratios, data centers generate millions of dollars in state taxes, even in states that have sales and use tax exemptions on some data center equipment. That same JLARC study showed that in 2017 Virginia gained $1.09 in state tax revenue from data centers for every $1 of state sales tax revenue exempted. Moreover, businesses in the data center supply chain, data center employees, and employees in the data center supply chain also generate additional state tax revenue as they spend the money they receive from data centers.