



AWS Economic Impact Study

AWS Investment in Virginia

AWS Economic Development | 2021

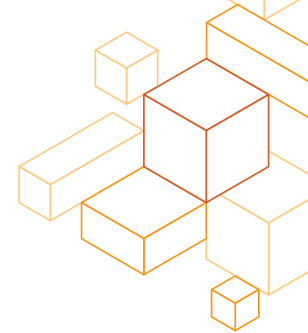




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Executive summary



**\$35
billion**

AWS data center investment
in Virginia (2011-2020)

13,500

Jobs supported through
data center construction and
operation (2020)

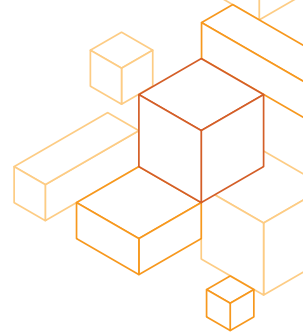
8,800

Regular full-time AWS
employees (September, 2021)

This report provides an overview of Amazon Web Services (AWS) investment in Virginia, which includes data center construction and operation, employment, workforce development, education and community engagement, and renewable energy. These investments have produced substantial economic benefits to the people and the economy of Virginia, among them:

- Over the last decade (2011-2020), AWS has invested \$35 billion in data centers located in Northern Virginia. This investment includes imports of highly specialized and proprietary equipment, and local spending on construction labor and materials, utilities, security, our data center employees and many other services needed to build and operate data centers.
- In 2020 alone, AWS investment in the construction and operation of data centers contributed \$1.3 billion in GDP and supported over 13,500 jobs in the economy of Virginia. This estimate is based on the input-output methodology, the U.S. Bureau of Economic Analysis (BEA) data for Virginia, and Amazon internal data.
- AWS is among the largest private-sector employers in the state, with over 8,800 full-time, well-paying jobs in corporate offices and data centers across Virginia. These roles include data center technicians, engineers, solutions architects, sales representatives, account managers, software development engineers, and cloud experts.
- Among other taxes, AWS paid over \$220 million in business personal property taxes in 2020 in connection with its data centers located in Fairfax, Loudoun, and Prince William counties. This amounts to 20% of personal property tax revenues received by these counties in the 2020 fiscal year.
- By 2023, Amazon plans to enable 15 new utility scale solar farms across Virginia, with a total capacity of 1,430 megawatts (MW) — enough renewable electricity to power 225,000 households, more than in Prince William County.

AWS in Virginia

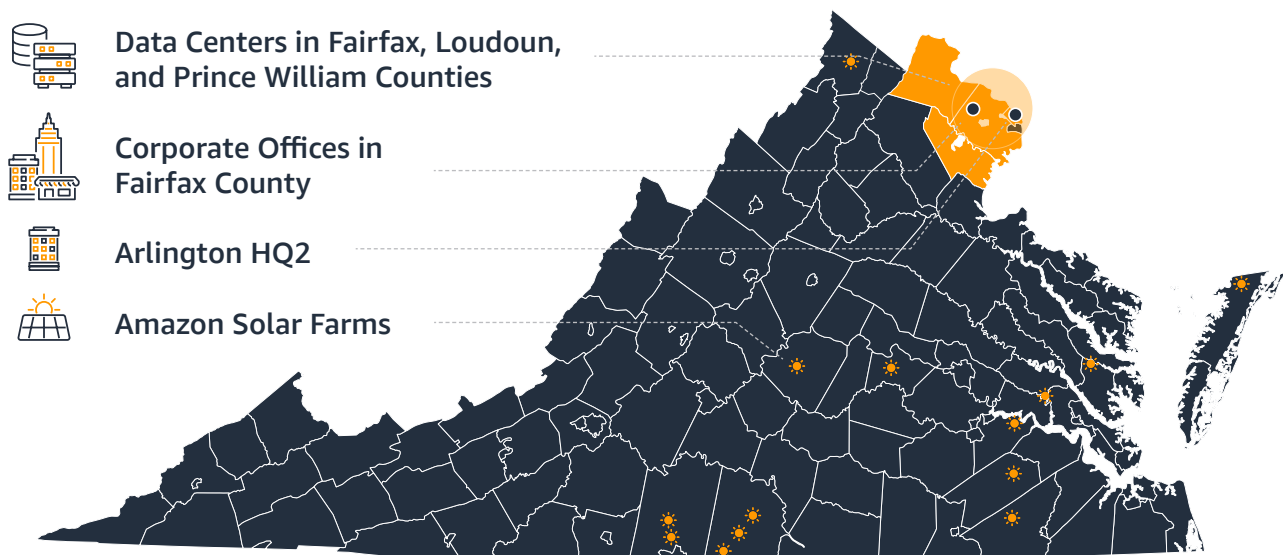


AWS turns 15 years old in 2021. Our story began in Virginia, in 2006, when the company started offering IT infrastructure services to businesses in the form of web services — now commonly known as cloud computing. Today, AWS is the world's most comprehensive and broadly adopted cloud platform. Millions of customers, including the fastest-growing startups, largest enterprises, and leading government agencies, use AWS to lower costs, become more agile, and innovate faster.

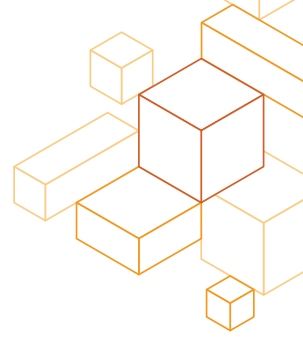
Since the launch of our first AWS data center in 2006, AWS has continued to expand its footprint in Virginia, to meet the growing demand for cloud services. Our most recent expansions include a new AWS corporate office in Fairfax County in 2017, and the opening of the first office in the new Amazon headquarters in Arlington in 2019.

Today, AWS is among the largest private-sector employers in Virginia, with over 8,800 full-time, well-paying jobs in corporate offices and data centers across Virginia. In 2021, in the middle of the pandemic, AWS accelerated hiring in Virginia, adding over 1,400 new full-time positions, as well as over 1,000 new contract-based data center roles, in areas such as security, facility maintenance, electrical and mechanical contracting.

As part of our Climate Pledge, we are committed to investing in renewable energy projects in Virginia. Amazon recently announced a new 120 MW solar project in Pittsylvania County that will power new headquarters along with other Amazon operations across the Commonwealth. By 2023, Amazon plans to enable 15 new utility scale solar farms across Virginia, with a total capacity of 1,430 megawatts (MW) -- enough renewable electricity to power 225,000 households, which is more households than in Prince William County.



AWS data center investment in Virginia



The AWS infrastructure is organized into Regions, which are clusters of data centers. The AWS Northern Virginia Region serves millions of customers around the world, providing them with the most security, reliable and extensive cloud services — including Virginia companies who benefit from the proximity of fiber network, data centers and the pool of tech talent attracted to the area.

AWS has invested over \$35 billion in the expansion of Virginia data centers over the last decade. These investments include:

- Capital expenditures on the development of data centers, including construction, servers, networks, equipment, and other capital assets
- Operating expenditures on the operation and maintenance of the data centers, including the wages and salaries paid to employees and other expenditures such as utilities, facility costs, and purchases of goods and services from regional businesses.

**\$35
billion**

AWS data center investment
in Virginia (2011-2020)

These expenditures have significant impact on the State's economy, bringing direct, indirect, and induced economic benefits. This economic ripple effect spreads to the broader economy through increased business sales in the AWS supply chain, and through increased household expenditure financed by higher earnings of regional residents.

Measuring Economic Impact



Direct Effects

Investments in construction and expenditures for operations



Indirect Effects

Inter-industry and supply chain spending



Induced Effects

Household income spending in local economy

Economic impact from the AWS data center construction in Virginia

Since the AWS Northern Virginia Region was launched, AWS has continued to make significant capital expenditures as data centers are progressively added to support growing customer demand for cloud services.

The construction activities associated with AWS data centers in Northern Virginia have produced significant economic impact on the economy of Virginia. We estimate that over the decade, 2011 to 2020, our construction activities have contributed \$4.3 billion in added value (GDP of Virginia) and 38,000 full-time equivalent (FTE) job-years in Virginia. These estimates are obtained by combining detailed AWS investment data, the U.S. Bureau of Economic Analysis (BEA) data for Virginia and input-output methodology (IMPLAN economic modeling software). Figure 1 illustrates the construction-related jobs supported over time.

In 2020, the AWS expenditures associated with construction of new data centers and expansion of existing ones have supported approximately 8,000 FTE jobs in the region. This figure includes 4,100 on-site workers directly involved in construction activities (according data provided by our general contractors); 1,300 indirect jobs in the local supply chain; and 2,600 induced jobs in the broader economy.

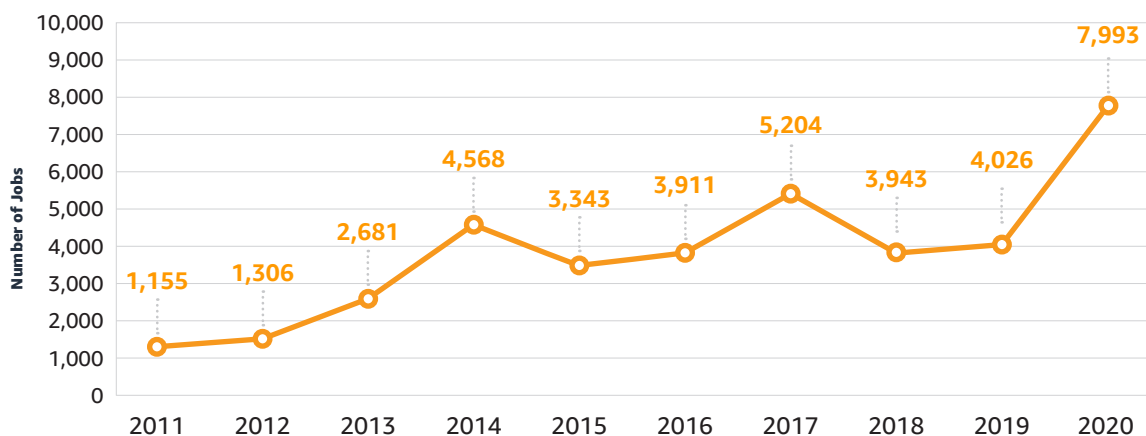
**\$4.3
billion**

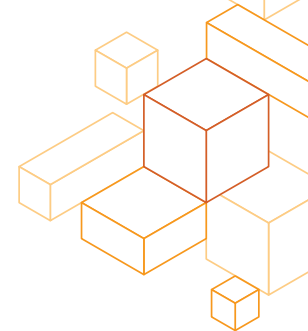
Contribution to the GDP of
Virginia (2011-2020)

8,000

Jobs (FTE) supported by AWS
data center construction in 2020

Figure 1: Virginia jobs supported by AWS data center capital expenditures, by year





Economic impact from the AWS data center operations in Virginia

The annual economic impact generated from the AWS data center operations is a source of long-term economic sustainability for the economy of the Commonwealth. We estimate that over the decade, 2011 – 2020, our expenditures associated with operating AWS data centers in Virginia have contributed an additional \$2.4 billion to Virginia's GDP. These estimates are derived using an approach similar to what we used for the construction-related impacts.

The operation of AWS data centers requires a highly skilled workforce of technicians and engineers to troubleshoot complex infrastructure issues, maintenance specialists to ensure the continued operability of electrical and mechanical equipment, and security personnel to ensure that the data centers meet the stringent security requirements. In addition, our expenditures on vendor services, utilities, and materials support offsite jobs in our vendor's supply chain and the broader Virginia economy. Table 1 shows examples of jobs in each category.

**\$2.4
billion**

Contribution to the GDP of
Virginia over 2011-2020

5,500

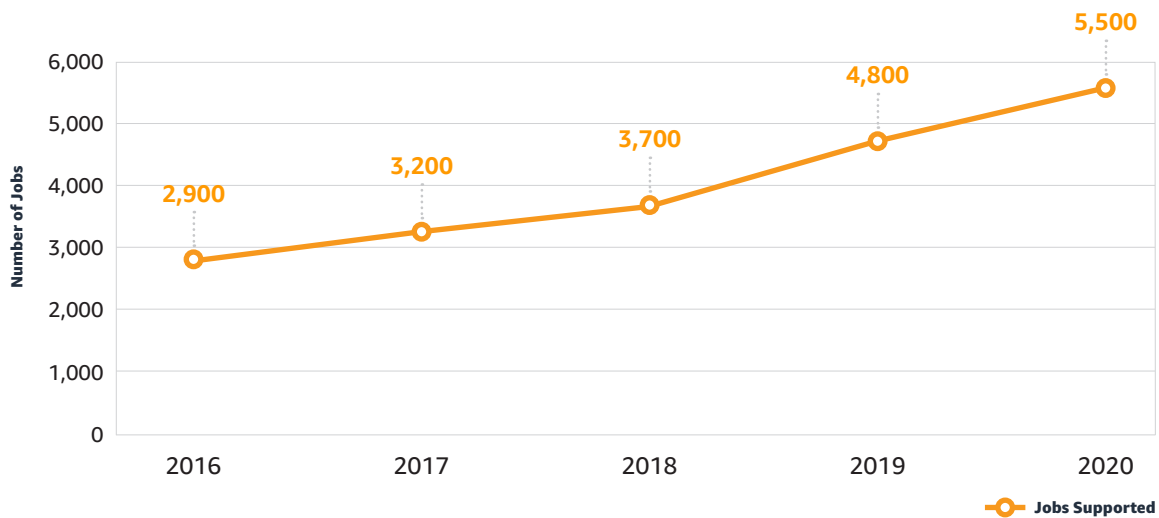
Jobs (FTE) supported by
AWS data center operation
in 2020

Table 1: Job types supported by AWS data center operations

(1) AWS data center employees (onsite)	(2) AWS vendor jobs (onsite)	(3) Offsite jobs supported
Data center technicians Facility managers Data center engineers IT support engineers and associates	Security guards Electrical contractors Facility maintenance Equipment repair and maintenance Cabling technicians	A variety of jobs in sectors where we spend and sectors that support our vendors

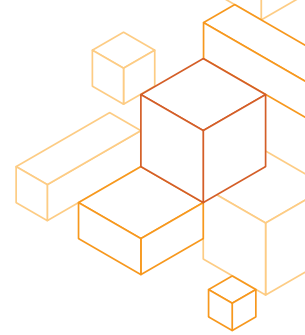
We use Amazon's internal employment data to obtain the number of onsite jobs, and the input-output methodology to estimate the offsite job impacts. Figure 2 presents the combined results, by year.¹ For instance, in 2020, our internal Amazon data indicates that data centers in Virginia maintained 3,500 FTE onsite jobs (combined columns 1 and 2, Table 1) which include both full-time AWS data center employees and part-time contract workers whose work hours were converted into a full-time equivalent for an equivalent comparison. Furthermore, our expenditures supported an additional 2,000 jobs outside of data centers (column 3). The total impact is 5,500 FTE jobs supported by AWS data center operations in the Virginia economy.

Figure 2: Virginia jobs supported by AWS data center operations, by year



¹ Estimates are restricted to years 2016-2020 for which necessary data was available.

Local business support by AWS in Virginia



AWS relies on the support of more than 100 Virginia businesses to build and operate its data centers, spending over \$1.8 billion on purchasing goods and services from these vendors in 2020. Our spending directly supports jobs in these businesses, and employment in associated sectors of the Virginia economy – over 5,500 FTE jobs in total (see the previous section). The following table provides a few examples of our vendors.

Table 2: Examples of businesses supporting AWS data centers in Virginia

Company	Line of business
Apex Companies	environmental consulting
B&S Site Development	excavation and grading, building construction
Chemstar	water treatment services
Helix Electric	electrical contractor
Prosecur Security USA	security services
Subsurface Technologies	environmental and construction services
Wisetek	IT asset disposal services

The positive impact on our vendors in Virginia goes further than our spending. The experience of meeting the high standards required by AWS helps our suppliers bring their service to a higher level of quality. In addition, the reputational benefit of working for AWS helps them acquire new customers in Virginia's substantial data center industry. To obtain further insight, we have conducted a poll of our vendors, receiving 19 responses in total. The responses are remarkably consistent:

Figure 3: Impact of AWS data centers on the business growth of vendors



²The designation of Virginia business refers to the physical presence (office, employment) in Virginia rather than a formal place of ownership. Foreign multinational companies are excluded from this designation.

Some respondents provided further detail on how doing business with AWS helps them grow.

“AWS has helped Prosegur expand in key markets in the U.S. and has helped Prosegur validate its Integra model, which combines traditional guarding services with cutting-edge technology in unique, client-specific solutions that improve the effectiveness and efficiency of the client’s security capabilities.” - Forrest Dane Dodd, Senior VP, Operations, Prosegur Security USA, a security service company in Herndon, VA

“We truly appreciate what these opportunities with AWS has done to drive our growth, level of expertise and overall company health. Also, as a whole, we feel that the AWS volume in this market has also created demand and growth with other data center providers and end users as a whole.” -- Carl Lechner, Director, Business Development, B&S Site Development, LLC, an excavation and grading company in Bristow, Virginia

“As an important, demanding, and advanced client who is purchasing a highly technical product, Amazon has helped us further develop our workforce to have more people capable of highly technical work of the very highest quality. This will benefit us across all market sectors.” – Helix Electric, and electrical contractor in Chantilly, Virginia

“AWS granted us our first entry into data centers. Our services have proven a good fit, and we have been fortunate to establish our name as a provider of 24-7 maintenance and care for mission-critical hyperscale centers.” - Cem Candir, President and CEO of Chemstar, a water treatment company in Baltimore County, Maryland

Among the 19 vendors that responded to the survey, 2,752 employees are involved in work for AWS. Out of them, 2,615 are additional new hires. A conservative extrapolation to 100 vendors (omitting security contractors who employ an unusually large number of people) indicates over 5,500 additional new hires made among AWS supply chain in Virginia, not counting direct AWS employment. Typically, these employees spend only part of their time doing work for AWS, which makes this number not directly comparable to the estimates presented in the previous section (which are expressed in full-time equivalents). Qualitatively though, the magnitudes of job creation obtained by two different methods are in line with each other, confirming the hypothesis that AWS data center operations in Virginia creates numerous jobs outside of the perimeter of a data center.



AWS workforce development in Virginia

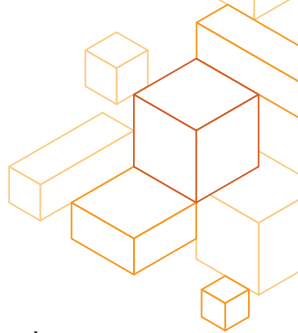
AWS develops collaborative initiatives between education systems, governments, economic development organizations, and employers to create a variety of pathways to cloud careers in Virginia. This includes K-12 school districts, community colleges, and universities across the state that create certificates, two-year and four-year degree programs, or other credentials to help learners build skills aligned with careers in cloud computing.

Through AWS education programs such as AWS Academy, Virginia educators get access to free, ready-to-teach cloud computing curricula that prepares students to pursue industry-recognized AWS Certifications and in-demand cloud jobs. AWS Educate also provides learners with online, self-paced cloud learning resources at no cost. AWS re/Start is a full-time training program that prepares unemployed and underemployed individuals for careers in the cloud and connects them to potential employers in the Commonwealth.

As AWS collaborates with Virginia leaders to upskill current workers and build the next generation tech workforce, initiatives have been developed to meet learners where they are, at various skill levels.

In collaboration with the U.S. Department of Labor in 2017, AWS established the Amazon Military Apprenticeship Program in Northern Virginia, an upskilling program that trains veterans and military spouses for roles requiring in-demand skills such as cloud computing.

In 2018, Northern Virginia Community College launched a cloud computing specialization as part of its Information Systems Technology Associate of Applied Science degree, one of the first cloud computing degrees in the nation offered by a community college. The following year, Northern Virginia Community College and George Mason University worked with AWS education programs to launch a bachelor's degree program that won Partnership of the Year by Education Dive in 2019.



The AWS Grow our Own Talent team has two programs in Virginia to bring local talent into our data center operations--a campus internship program operated in concert with local colleges and trade schools, and a work-based learning program for high school graduates. In the past two years, we have placed over 60 campus interns and 150 work-based learning program trainees in our Virginia data centers. For example, 32 work-based learning program trainees hired in 2020 were from Prince William County Public Schools (PWCS), Loudoun County Public Schools (LCPS), and Fairfax County Public School (FCPS). These individuals participated in a 12-week paid, full-time training program and if successful, were offered full-time employment at the end of the program.

Government and policy leaders of Virginia have been instrumental in ensuring employers throughout Virginia have access to a skilled workforce to support the growing need for tech workers with cloud computing skills.

“The field of cloud computing is growing and dynamic, and we know that for our Commonwealth to reach new heights and remain a national leader in tech talent, we must build seamless pathways from classrooms to careers at all education levels,” said Governor Northam. “This initiative represents exactly the kind of cooperation we need to ensure that Virginians have access to the skills they need for 21st-century jobs, while also helping employers find Virginia workers with the right training to fill those jobs.”

AWS community outreach in Virginia

AWS Think Big Space

The world's first Amazon Web Services Think Big Space opened at River Oaks Elementary in Woodbridge, Virginia in 2019. The Think Big Space is a partnership with Prince William County that encourages students to think big by using a growth mindset to solve problems and prepare for innovative careers that do not yet exist. The "Think Big Space", named after one of Amazon's leadership principles, is designed to look like an Amazon work environment.



The space provides a colorful and stimulating atmosphere with access to 3D printers, drones, Fire tablets with augmented reality, and more. On the opening day, fifth-grade students at River Oaks Elementary learned about plant and animal cells and watched paper renderings come to life through the use of 3D technology. Though located at River Oaks, the space is available to 2,500 elementary students from 20 nearby schools, allowing other students to think big and pursue careers in science, technology, engineering and mathematics (STEAM).

AWS Girls' Tech Day

AWS Girls' Tech Day is a global event designed to inspire and empower young girls from grades 3 to 12 and young women 18 to 24 years of age to pursue interests and careers in technology. It is a series of learning workshops focused on science, technology, engineering, arts, and mathematics (STEAM). Prince William County Schools participated in this event to inspire girls within the district to pursue careers in STEAM. In 2020, the Northern Virginia Technology Council (NUTC) presented AWS with the Community Champion award for the 'Girls' Tech Day. Since its launch, this AWS Girls' Tech Day has reached thousands of girls and young women in the Americas, Europe, Asia, Australia and Africa.



Local volunteerism

AWS is committed to making a positive impact in the communities where its employees live and work. Employees at AWS support efforts and causes to alleviate the pressures that many communities of Northern Virginia face, especially those impacted by the COVID-19 pandemic.



"If this is your passion, you can do it here."

By Terry Dickerson, Practice Manager at Amazon Web Services and U.S. Army veteran

In the late 80s early 90s, MacGyver and the A-Team were two of the popular shows in my grandparents' home. I would spend countless hours imagining that I had the skills to take seemingly random components and invent a simple solution to get out of a tight jam. One day, I came across a junk computer while visiting my relatives. I was immediately hooked. It had everything – wiring, circuitry, and other components that I couldn't name at the time. I looked at those components and saw a world of possibility. When I graduated from high school, I joined the U.S. Army and served multiple tours of duty. During that time, I would ask, "How can technology could help me and my fellow soldiers?" I would tinker to find the answer. At one point, I built an internet café by assembling a satellite receiver in a bunker in Baghdad, so that soldiers could stay connected to our families back home. When I left the military, I knew I wanted a career in technology. I had watched a number of documentaries about starting an IT career, and the plan seemed clear: I had to get myself to Silicon Valley, to find a job and a mentor who could help me build a career. So, I started shopping for an RV. I budgeted for six to eight months of living in the RV. I hoped that by then, I would have my foot in the door. It was daunting to being leaving the military, but I assumed I had to close that chapter of my life to start the next one. I was wrong.

Before I hit the road to California, two Amazon recruiters visited the base where I was stationed. I told them my plan. They asked if I had heard of Amazon's Veteran Technical Apprenticeship program that was launching at Northern Virginia Community College. For the first time, I saw that someone wanted me to bring my military experience to the table – not leave it behind.

I moved to Virginia and enrolled in the program in 2018. It was more than a class. In addition to learning the technology, I learned how to be a civilian. Our instructors from the school were former military too. They understood how we veterans react when we're frustrated, when we're inspired, and when we're confused and need more help.

Just as important, I learned that there is a whole sector of Amazon that is based here in Virginia that supports government customers. And we're part of an entire technology industry in Virginia that is dedicated to serving customers like the U.S. military. Just knowing that I can still do the things that are close to my heart, is something I never expected. For years, I've kept a notebook of all the improvements that could be made for men and women in the military. I thought I would have to give that up to start a technology career. But being in Virginia, it is a central part of my job. A while back, I was telling my mentor about some challenges I knew soldiers faced at my old base. I



thought technology could help. My mentor encouraged me to write up a plan, which I then presented on behalf of Amazon to the U.S. Army. As a result of that meeting, we eventually held a briefing with a four-star general about the work we do.

One of my biggest takeaways from my entire journey is that not enough people know about the possibilities here in Virginia. How many other people think that you have to go to California to start your IT career? I'm so excited that Amazon has created opportunities for veterans like me right here in a community I'm proud to call my home.

AWS's Commitment to Veterans

In 2016, Amazon made a public commitment to hire and train military veterans and spouses. Our training and apprenticeship programs work in collaboration with state and federal government, veterans' organizations, and educational institutions. Our programs help transitioning service members and spouses develop skills to prepare them for AWS software development, support, and data center operations roles. Amazon committed to hiring 25,000 military veterans and spouses, for Amazon and AWS roles, by 2021. Additionally, we committed to providing AWS training to 10,000 active duty service members, military veterans and spouses through our AWS Educate program, offering them a path to AWS certification. To celebrate AWS' 4th year working with veterans in the region, a Veterans bike ride and a Veterans in Arts initiative was organized this year.



Right Now Needs Fund

Amazon launched the Innovative "Right Now Needs Fund" program to help remove barriers to learning for thousands of students in need across 59 Northern Virginia schools amid COVID-19. The \$1 million donation was made to ensure students in Arlington Public Schools and Alexandria City Public Schools could secure basic necessities, including food, school supplies, hygiene products, and more.

Amazon recently donated nearly 800 Mi-Fi mobile hotspot devices and \$75,000 to secure thousands of headsets for students across northern Virginia starting the school year from home. In addition, since the start of the COVID-19 pandemic in Amazon's HQ2 region, Amazon has donated \$1 million to kick-start emergency response efforts; provided thousands of devices to groups supporting students in need; donated cash and in-kind products to local nonprofit organizations and food banks; paid local restaurants to prepare and deliver 10,000 lunches and dinners for first responders, frontline healthcare workers, and vulnerable neighbors; and funded delivery services to provide more than 50,000 meals—60,000 pounds of food—directly to the doorsteps of local seniors and those disproportionately impacted by COVID-19.

Amazon also donated \$3.9 million to nonprofit CodeVA to help make virtual computer science curriculum and training available to Virginia teachers and students so that they don't fall behind in learning this increasingly important skill set. Currently, more than 50 Virginia schools, and counting, are part of the Amazon Future Engineer program.

"AWS is proud to be a member of the communities in Virginia. We endeavor to be a positive force in all the communities we work in through our programs, investments, and the volunteering done by our employees." – Shannon Kellogg, Vice President of Public Policy, Americas



AWS and sustainability

As part of Amazon's Climate Pledge, Amazon is committed to reach net-zero carbon emissions across its business by 2040. Part of that commitment is powering Amazon's infrastructure with 100% renewable energy, and the company is now on a path to achieve this milestone by 2025, five years ahead of the initial 2030 target. As of December 2020, Amazon became the world's largest corporate purchaser of renewable energy. We have 232 renewable energy projects across the globe that have the capacity to generate over 10,000 megawatts (MW) and deliver more than 24 million megawatt hours (MWh) of energy annually—enough to power more than 2.26 million U.S. homes.

Amazon recently announced a new 120 MW solar project in Pittsylvania County that will power Amazon's new HQ2 headquarters along with other Amazon-owned operations across the Commonwealth of Virginia. By 2023, Amazon plans to enable 15 new utility scale solar farms across Virginia, with a total capacity of 1,430 megawatts (MW), and total investment of \$2.1 billion. According to our estimates, the construction will support 6,050 FTE jobs in Virginia.

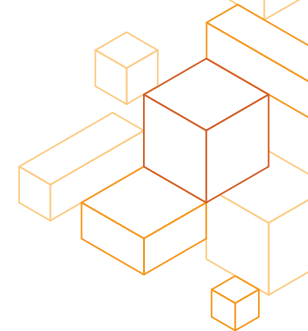
AWS is committed to running our business in the most environmentally friendly way possible and supply renewable energy to the grids powering AWS data centers, and achieving 100% renewable energy usage for our global infrastructure. In addition to helping our customers increase agility and reduce costs, moving to AWS is also much more sustainable. Customers no longer have to provision for peaks, and AWS's infrastructure is designed to operate efficiently at scale. A recent study by 451 Research found that AWS's infrastructure is 3.6 times more energy efficient than the median of surveyed enterprise data centers, with more than two thirds of this advantage due to a more energy efficient server population and higher server utilization.

"When we factor in the carbon intensity of consumed electricity and renewable energy purchases, which reduce associated carbon emissions, AWS performs the same task with an 88% lower carbon footprint." - 451 Research, 2019

Reducing water usage in AWS data centers

AWS has multiple initiatives to improve our water use efficiency and reduce the use of potable (drinking) water for cooling data centers. In Virginia, AWS was the first data center operator to be approved to use recycled water with direct evaporative cooling technology. AWS partnered with Loudoun Water to demonstrate the benefits of recycled water for industrial cooling applications and shared the best practice of using recycled water in the data centers.

Appendix: Input-output methodology



To compute the economic impact of data center investments, we use the input-output multiplier methodology. Input-output models are used to measure the impact of the expansion or contraction of one economic activity on other economic activities and on the local economy as a whole. The Input-Output methodology is credited to Harvard economist Wassily Leontief, who was awarded the Nobel Prize in economics for the development of this method and its applications. The method uses historical data from the country's statistical agency that produces tables for this purpose, which in the case of United States is the Bureau of Economic Analysis. The data shows the impact of each dollar spent in one industry on all other industries: for example, a dollar spent on construction might typically be associated with 20 cents spent on electricity and other utilities. We also use internal Amazon spending and investment line-item data on how much we will spend on each industry while building and maintaining the data center. For more information, see Ronald Miller and Peter Blair, "Input-Output Analysis: Foundations and Extensions," 2009, Cambridge University Press.

In analyzing how the economic impact of AWS investments ripple throughout the regional economies, we break down economic impact into the following effects:

- Direct effects, which are increases in employment and labor earnings of individuals either employed by the AWS data centers or by firms that directly supply AWS, and the increases in economic output produced by regional businesses, such as construction companies and goods and services providers—which are directly attributable to the capital expenditures and operating expenditures of AWS;
- Indirect effects, which are increases in employment, earnings, and GDP created at other regional businesses, such as transportation companies and other goods and services providers, that are not direct suppliers to AWS but experience increases in demand due to the increase in expenditures by the companies that directly supply AWS;
- Induced effects, which arise when the income earned by residents of the region is spent at regional businesses, including expenditures such as meals at local restaurants, purchases from retail establishments, purchases or rental of housing, and purchases from the providers of personal services.

Our application of the input-output method in this study relies on IMPLAN economic modeling software, a well-known and respected tool among economic development practitioners in the United States.

