

March 11, 2026

Inside Amazon's approach to data center sustainability: A conversation with Brandon Oyer

Brandon Oyer, head of energy and water for AWS, and Tessie Petion, head of ESG Engagement, discuss how we manage data center growth alongside our energy and water use, engage with communities, and balance expansion with our sustainability goals.

Tessie: Brandon, thank you so much for being here. Over the past few years, data centers and artificial intelligence (AI) have moved from a niche infrastructure subject to one of the most closely watched topics for investors. From my conversations with sustainable investors, I know that our shareholders want to understand how we're managing data center growth alongside our energy and water use, how we're engaging with communities, and how we're balancing expansion with our long-term sustainability goals. I'd like to explore all of that today – the strategy, the considerations, and the progress.

Let's start by talking about you and your background. You've been at Amazon for almost eight years and lead the Energy and Water team for the Americas for Amazon Web Services (AWS) – but your path here was unconventional. What were you doing before you joined Amazon, and how did that experience shape the way you approach the infrastructure and sustainability decisions we're facing today?

Brandon: Yeah, thanks for making the time to chat today. I'm Brandon Oyer, and I lead AWS's energy and water strategy. You're right, I've taken a rather unconventional path. I started my career in the United States Navy. My undergraduate degree is in nuclear engineering, I have a master's in engineering management, and I'm a licensed Professional Engineer (PE) here in the state of Washington. I spent a lot of my career before Amazon serving on nuclear submarines. I started on a Fast Attack submarine, then on a ballistic missile submarine, both of which operate in very mission-critical, zero-defect worlds. The job was to generate power and propulsion to run everything. That included the life support systems necessary for spending months at a time underwater on a submarine – from making the air we breathed to the water that we drank. I tallied it up once, and I've lived about two years of my life underwater, which was pretty fun considering I also gained a lot of responsibility and experience so early in my career.

From there, I moved into the private, non-regulated energy sector, running a small utility that produces thermal energy right here in Seattle. One of my first projects after I left the Navy to become a civilian engineer was finding a way to reuse heat the plant would normally waste and turn it into energy so it could run more efficiently and use less energy. I also worked on an effort to save fresh water before it was lost to Elliott Bay, saving nearly 100 million gallons of drinking water each year, enough to supply thousands of homes.

That seems to have set the stage for what my focus has been since: finding practical ways to use energy and water more efficiently. And that's the mindset I bring to work every day when it comes to Amazon's data centers, so we're using energy and water more responsibly and not letting valuable resources go to waste.

Joining Amazon gave me the chance to go deep on both sides of this work — leading data center design, then hardware development, and now energy and water strategy. I've had exposure all the way down to the motherboard level, and all the way up to how we think about grid-scale power and water sustainability. I feel lucky to have that kind of full-system view. There is never a dull moment, but it's been a fun ride.

Tessie: Can you tell me about the team you lead? What's your North Star? What's the principle that really keeps you oriented when the work gets complicated?

Brandon: As you know, with everything at Amazon, we start with the customer and work backwards. So, our goal is to deliver power and water for Amazon data centers across North and South America to meet our customer demand and do it responsibly. When I say responsibly, I mean keeping costs low for our customers, so that Amazon can offer more services while keeping our own costs in check. But it also means being a good neighbor to the communities where we operate and where our customers live. That includes paying for the costs to power our data centers, so expenses aren't added to the bills of local residents or businesses. That takes more than just paying the power bill, it also means working with utilities and regulators to make sure we're paying for the transmission infrastructure and investing in bringing new power sources to the grid. It also means we design and operate our facilities with the environment in mind. From the top of Amazon leadership, all the way to the people who are building and monitoring our substations, we're all aligned on the mission. We are building responsibly, building economically, and striving to be the most responsible partner who is deeply invested in strengthening our communities. That is our North Star.

Delivering on that in a very complex space — that touches communities, government, regulators, and utilities — we have invested in tremendous talent throughout my organization, from our real estate, economic development, and public policy partners, all the way through our legal, accounting, and finance teams. Amazon invests significant resources in the people who run this business, and all of us have this same North Star: do what's right for our customers and communities, grow the business, and do it all responsibly.

This talented team has enabled us to confidently set and deliver on ambitious goals. We continue to be one of the world's largest purchasers of carbon-free energy, with more than 700 projects globally. Amazon is investing in over 40 gigawatts (GW) of carbon-free energy, which is enough to power more than 12.1 million U.S. homes.

We've also set a goal to be water positive by 2030, meaning we'll return more water than we use in our data center operations, and we're 53% of the way there. We do this through conservation projects, water reuse programs, and replenishment initiatives that provide tangible benefits to local communities. I track our progress towards our goals every month. These results are a direct reflection of the industry-leading expertise across this team — and that same expertise is what gives me confidence that we will continue to execute smartly and deliver on behalf of our customers.

Tessie: Before we get into the specifics of how Amazon is managing its energy and water use, I want to zoom out for a moment. We're living through two massive, simultaneous shifts: an AI revolution that's reshaping how businesses and individuals interact with technology, and a broader electrification of society — transportation, buildings, industry — that's fundamentally changing how we think about energy demand. Data centers sit at the intersection of both. There's a real tendency to treat data center

energy use as a cost without a corresponding benefit. But data centers power some of the most critical work that's happening in the world today, from weather prediction to healthcare and scientific research. How do we tell a more complete story about what AWS infrastructure supports and why it matters, especially as the conversations around data center energy use intensifies?

Brandon: You're right. Just like we rely on electricity and water every day without thinking about it, data centers are part of the infrastructure powering the things people depend on. You don't see them, but they keep daily life running, supporting the apps we use, the transactions and operations that keep businesses open and people working, and the critical services we count on, like first responders having the right information in times of need.

AI is part of the increase in energy demand that we're seeing now, but it's not the whole picture. As a society, we continue to find ways to use data to make our lives easier, more efficient, and more connected. For example, when you visit your doctor and they update your health records, when you join a video call, stream content, connect with friends on social media, bank online, or complete a transaction at the grocery store— all of those interactions are running through a data center.

AI is reshaping what data centers need to do — workloads are becoming more sophisticated, and we're continuously evolving our infrastructure to keep pace with that, both in how facilities are designed and in how we're managing the operational demands of running inference at scale.

Tessie: When you look across different types of data center operators, from cloud service providers, to enterprise data centers, to smaller players, where do you see the biggest differences in approach to energy and water efficiency?

Brandon: Amazon always focuses on our customers, and our customers want us to always offer more value from our services at a lower cost. They also expect a high-bar from Amazon in terms of corporate citizenship, including that we're forward-leaning and setting ambitious goals and commitments for our operations, like being net-zero carbon by 2040, water positive by 2030, investing in workforce development, and strengthening the communities where we operate. That focus drives everything we do – including how we think about efficiency. I tend to not spend a lot of time focused on others in the industry, but we do hold ourselves to a high standard and track our performance closely. We focus on efficiency – from the chip level, to our data center design, and through how we source on behalf of our customers – because that's the way that we continuously do more with less.

We're also transparent and publish metrics like our power use effectiveness (PUE) and our water use effectiveness (WUE) so customers and analysts can clearly see how efficiently we operate. Our global averages — of 1.15 PUE for power and 0.15 WUE for water – reflect that discipline. The simplest way to think about PUE is the closer you get to 1.0, the better. You'd be hard pressed to find better numbers in this industry.

One thing I'm super proud of is the depth of investment that Amazon makes in the communities where we operate. When we enter a community — whether to build a new data center, a fulfillment center, or invest in a new power purchase agreement (PPA) — we're making a commitment for the long-term. We support local jobs, generate economic growth, provide skills training and education, and create new opportunities for local businesses and suppliers.

In Oregon, for example, we've invested over \$60 billion since 2010, including infrastructure and compensation to employees. We've contributed tax revenue, invested in community centers and daycares, and helped the broader community grow. In Warren County, Mississippi, we're seeing what it looks like when opportunity comes to a community. People don't have to move away to find good jobs, they can stay, build careers, and be close to their families while the next generation sees a path forward right where they are. And when we invest \$12 billion in Louisiana, there's a flywheel effect that extends well beyond our direct investment. When I visit those sites and drive past the surrounding areas, I see a town where the local economy had stalled, and now the restaurants are full, hotel parking lots don't have a spot open, and small businesses are thriving again. That's real tangible economic impact.

Tessie: You've already shared that our data centers achieved a global PUE of 1.15 in 2024, which is better than the public cloud industry average of 1.25, and also better than the on-premises enterprise data center average of 1.63. What's driving these efficiency gains, and where do you see the most meaningful opportunities still ahead?

Brandon: Amazon is a deeply data-driven company, and we're extremely focused on the efficiency of our operations. We look at the data, and we challenge the status quo wherever there's an opportunity to do better. Cooling is one of the largest sources of energy usage in a data center, and it's an area where we've invested heavily in constantly innovating. We use different cooling techniques depending on the time of year and use real-time data from sensors to adapt to changing weather conditions. Wherever possible, we use outside air for cooling for as many hours of the year as we can because air is ubiquitous, efficient, and it's sufficient for cooling our servers. This approach also directly supports our water efficiency goals. When we can filter it and circulate outside air directly through our facilities, we don't need to use any water for cooling. In many regions, our data centers use water less than 10% of the year to support operations. In water-scarce regions like Phoenix, Arizona, Bahrain, India, Mexico, United Arab Emirates, Saudi Arabia, and South Africa, we don't use water for cooling our data centers.

At a certain temperature on some days, however, we may have to use water through a direct evaporative process. It is actually very simple. Well, maybe it's simple for me as a mechanical engineer who studied thermodynamics. It's similar to when you sweat and when the water evaporates, it carries heat away with it to help cool you down. We apply the same principle in our data centers, but only when absolutely necessary. We continue to push the envelope, extracting more efficiency from every bit of power and every gallon of water without negatively impacting the customer experience.

Some companies opt for chillers — essentially large-scale air conditioning systems — to cool their data centers. However, based on current technology, using water during peak heat periods actually results in a lower overall environmental footprint. Chillers typically consume 25-35% more electricity than water-based cooling, and that added demand tends to spike at the exact moments when the broader grid is already under its greatest strain — when homes and businesses are running fans and air conditioners at full capacity.

After evaluating all available options, we concluded that using water on the hottest days of the year is the more responsible choice than placing additional stress on the electrical grid during its most vulnerable moments.

One key initiative is our work with reclaimed/recycled water, which is sewage that has been treated and cleaned so it can safely be reused and sourced from treatment plants. By working with local water

utilities and investing in upgrading their treatment facilities and piping to our facilities, we're strengthening water sheds and ensuring that drinking water is not used for cooling our data centers. We currently operate 24 facilities running entirely on reclaimed water, and we have an additional 130 facilities under contract to adopt reclaimed water systems around the U.S. and worldwide. We played a foundational role in establishing the very first reclaimed water programs in Mississippi, Hong Kong, and Indonesia, covering the full cost of infrastructure development and supporting the permitting process.

We've also innovated to meet the growing demands of AI workloads, which generate more heat and require chips to be positioned close together. Our teams designed and delivered a custom next-gen In-Row Heat Exchanger that uses a safe direct-to-chip liquid cooling approach — a cold plate on the chips with liquid running through a sealed closed loop that continuously removes heat without increasing water use. This lets us support both traditional and AI workloads in the same facilities. Our solution uses 9% less water than fully air-cooled sites and delivers a 20% improvement in power efficiency compared to off-the-shelf alternatives.

We've spent years iterating and testing to maximize the efficiency of our operations. We've also made significant investments in our people — subject matter experts who have spent their careers designing cooling systems and hardware, and who continue to drive innovation on behalf of our customers. That combination of investment in technology and talent is how we find new efficiencies every day — and why we believe the best numbers are still ahead of us.

Tessie: When our teams are evaluating a new data center region, how do energy availability, grid reliability, and water access factor into that decision?

Brandon: As someone who thinks about energy and water probably every waking hour, absolutely energy and water are important factors, but it takes a lot more than that to build a data center. We look for locations that are well suited for long term infrastructure, with lower exposure to natural risks, and communities that want to partner with us to bring jobs and investment to the region. Grid stability and reliability are also super important. We also need fiber to connect the data center and a skilled workforce — not only to build, but also to operate the data center. In Jackson, Mississippi, for example, we're building a new data center there, and there's approximately 4,000 people that come and go on any given day to make that site operate. When we're evaluating new regions, we proactively engage with utilities and regulators at the local, state, and sometimes federal level to assess whether a location makes sense, both for the business and for the surrounding community. We want to do what's right in the long term. Our communities are our customers, and we look to partner with communities that welcome us. Power and water are important, but they're also one part of a larger equation.

One thing I'm proud of is how we've built out our internal expertise to make these complex decisions. When we began building our renewable energy portfolio several years ago, we invested heavily in our own team of specialists. We brought on an expert with more than 20 years of experience modeling transmission systems, and she helped our teams identify the optimal locations to connect renewables to the grid. A couple years ago, as customer demand for new data centers really started to accelerate, we flipped that problem on its head. We started applying her transmission expertise in reverse — asking not just where we could add renewables, but where on the U.S. electric grid would additional load be the most beneficial? That analysis is one of the reasons why we ended up in Jackson, Mississippi, and South Bend, Indiana. We piece together a lot of data to make thoughtful decisions on where we're going to expand.

Tessie: Energy procurement is one of the most dynamic parts of your work right now. What are the most significant constraints you face, and how are you and the team approaching them?

Brandon: We want to procure the lowest cost and lowest carbon-intensive energy on behalf of our customers while making a positive impact on the communities around us. We have continuously found that putting additional load onto the electric grid requires us to invest in generation, and we have several examples where we've done that.

The U.S. electric grid is aging. Many assets are 40, 50, or 60 years old and will eventually need to be replaced. We believe the grid shouldn't be a blocker to addressing both energy and climate issues and so we're collaborating with grid operators, utilities, and others to ensure that new sources of carbon-free energy can connect to the grid quickly, and the grid can handle the energy demands of the future. We're one of the world's largest purchasers of carbon-free energy with a portfolio of more than 700 projects representing more than 40 GW of generation capacity, including four nuclear power agreements, 11 utility-scale battery storage projects, more than 300 utility-scale solar and wind farms, over 300 onsite solar projects, and six offshore wind farms in Europe.

When we bring material new load, for example 1 or 2 GW, to an area that requires local network, transmission, or generation upgrades, we fund those upgrades. That goes back to the North Star we discussed earlier: keep costs low, enable capacity, be a good neighbor, and avoid passing additional costs to other ratepayers. In March, Amazon signed the White House Ratepayer Protection Pledge, which reflects a commitment to fully cover the cost of electricity production required for AI data centers.

Much of what was outlined in the pledge is how we've been operating for a long time. We're working with grid operators, utilities, and others to help ensure the grid is prepared to meet current and future demand while not passing additional costs to other ratepayers. In fact, we're seeing that our long-term investments are generating benefits for the broader grid and for local communities. In February, Indiana utility American Electric Power Indiana Michigan (AEP I&M) announced base rate reductions for customers due to the load growth and increased revenue from large customers like Amazon. And in September, Entergy announced it plans to invest an additional \$300 million in grid improvements in Mississippi — at no additional cost to customers — because of new revenue from Amazon and other large customers. Those additional funds are expected to help improve grid reliability and cut power outages in half over the next five years.

Tessie: How does Amazon incorporate demand side management into how we're thinking about data center energy consumption?

Brandon: We have a posture of being available at required times, such that when our customers want to operate, they can. We put our customers first, and our customers determine when and where they use our services. We understand the importance of flexible resources to support power grids. It's also important to recognize that grid flexibility services are often dependent on cloud computing — demand response programs, battery storage systems, smart thermostats, and EV charging infrastructure are flexible because they run on the cloud. Our data centers support a broad range of customers, including government agencies, financial institutions, and emergency services, whose workloads are often mission-critical and must remain continuously available to ensure reliability, security, and public safety. We don't consider our data centers a flexible load. That said, during rare grid emergency events, our

data centers may support grid reliability by transitioning facilities to backup generators in close coordination with local utilities and regulators. We also see technologies like battery storage as a way to provide some level of demand-side response, and we're always evaluating how to leverage that technology — but we do that with a lens of not impacting customer availability.

Tessie: We've already talked about this a little bit, but will Amazon's data center energy demands raise rates for other energy users?

Brandon: To be clear, we pay the full cost of the electricity we use, and we pay for the additional infrastructure required to deliver that power to our data centers — including new transmission lines, substations, and other grid upgrades — without passing it on to other ratepayers.

Let's take one step back to discuss how utility rates are actually set. At the end of the day, a utility and its regulator — typically a public utility commission or public service commission — agree on rates based on a set of factors, including how much revenue the utility collects, how much capital expenditure they plan to deploy, what their operating costs are, and what their regulated rate of return will be. When Amazon enters into an energy agreement, we have a very clear understanding of what we're going to pay (i.e., how we'll affect the revenue side). With visibility into both the capital requirements and revenue, we can make informed estimates to make sure that we agree to a contract that's fair for our customers and doesn't negatively impact other ratepayers. Ultimately, it's the regulators and utilities — not Amazon — who set the rates. So, we try to be as transparent as possible and work collaboratively to balance the cost effectiveness with the capital investment that needs to be made.

Circling back to our AEP I&M collaboration — we're funding all of the infrastructure necessary to serve our new data center campus in Indiana. AEP I&M reported that they were able to reduce base rates for other energy users because of the increased revenue from our data center operations. It's important to remember that there are significant fixed costs to operate a utility. Once that capital is deployed and a return is expected, additional demand creates additional revenue. The excess revenue can offset rates and support ongoing grid modernization for the benefit of all customers.

Tessie: We've been one of the world's largest corporate purchasers of carbon free energy since 2020. The question isn't whether we're committed — it's what is standing in the way of going faster. So where are the real bottlenecks: is it permitting timelines, transmission constraints, interconnection queues? And how are we working with local utilities and regulators to address some of the bottlenecks that we see?

Brandon: Many of the factors you mentioned have to align for us to be successful. We work to get ahead of that by building relationships with the regulators and the utilities early, so they understand our mental model for growing the business responsibly.

On the permitting side, one of the most meaningful improvements would be a more streamlined, coordinated process — a one-stop shop for energy infrastructure approvals, if you will. Federal, state, and local county regulations can be quite complex to navigate simultaneously, because you can't break ground until all those permits are obtained. For something like a small modular reactor (SMR), for example, you're potentially coordinating with the Nuclear Regulatory Commission, the Environmental Protection Agency, the Army Corps of Engineers, and other state and county jurisdictions all at once. I'd say that's probably one of the bigger bottlenecks because of the complexity there.

We've also realized that Amazon needs to be a catalyst and invest capital in emerging technologies. Our \$500 million investment in X-energy is a good example of that. We wanted to avoid putting risk onto ratepayers, so we stepped in to help support broader industry momentum. The partnership between X-energy and Energy Northwest, for example, will provide offtake commitments that are essential to getting early-stage projects across the finish line, which can be a model for how the industry approaches the next generation of carbon-free generation.

When I think about some of the bottlenecks we face today, they fall into a few categories: commercial and regulatory constraints, and then the ongoing engineering challenges that come with building infrastructure at this scale — things like advancing cooling technologies and optimizing power delivery for increasingly demanding workloads. Our team of subject matter experts is actively working on and solving all of these. To move faster, we need to make progress on all fronts.

Tessie: We started talking about nuclear and SMRs specifically. What makes nuclear the right fit for our strategy? And also, when can we expect some of these projects to realistically come online?

Brandon: Nuclear energy is an important addition to our portfolio because it's carbon-free, firm, scalable, safe, and reliable. When you look at nuclear projects around the world, they've historically required very large capital investment and they tend to be one-off undertakings. Amazon has a long track record of scaling technology, and we identified SMRs as a technology where we could scale quickly, safely, and maintain high rigor throughout the process in a way that helps manage cost. The smaller scale of SMRs is also an advantage. Starting at 80 megawatts (MW) at a time, rather than 1,000 MW, means less capital is exposed before it starts to generate some revenue.

We see SMRs as a natural fit with Amazon's DNA and how we approach scaling and problem solving. However, we'd be happy with many different carbon-free generation technologies coming online, because that incentivizes the industry to continue to be cost-competitive. So it's not the only way forward, but it fits well with how we think through problems.

We continue to build out our internal expertise in this space, including hiring nuclear engineers and professionals who've worked at the Department of Energy. In terms of timelines, our goal is to deploy 5 GW of SMR capacity in the U.S. by 2039.

Tessie: What happens between now and then? Will Amazon invest in fossil fuel energy sources, like natural gas, to keep up with increasing power demand?

Brandon: We think it's important to think and act long-term. We're committed to investing in carbon-free energy, however meeting this demand will require new energy sources and multiple solutions.

As part of our expansion in Northwest Indiana, for example, we worked with local utility NIPSCO to secure 3,000 MW of capacity, including new natural gas generation that will power our data centers, and battery storage to support broader grid reliability beyond our needs. At the same time, we've also enabled 635 MW of carbon free energy investments in Indiana as of 2025. These efforts are consistent with our ongoing commitment to collaborating with utilities and energy providers to ensure we're covering all the costs to power our data center operations, supporting grid reliability, while also bringing new carbon free energy to the grid.

Tessie: Let's move on to another hot topic. We've been talking about it this entire time, but let's focus on water. What are we doing to reduce the amount of water used by our data centers, and how are we working to improve the water efficiency of our operations?

Brandon: We started out the discussion talking about how I've spent a couple years of my life underwater supervising reactor plant operations as part of the US Navy's Nuclear Submarine Force. One of my first big projects when I moved to the private sector was focused on conserving potable water. I'm also an avid outdoorsman and spend a lot of time on the Columbia River and its estuaries with my son, fishing and being in nature. I want to do what's right for our global community and the environment.

As a company, our water usage is widely misunderstood and it's important for me to discuss our approach. Our first priority is to maximize efficiency and reclaimed water opportunities internally wherever we can. We monitor water use in real-time, using sensor data to identify leaks, fine-tune mechanical cooling operational settings, and alert operators to inefficiencies before the problem compounds. We've also developed and are deploying our own custom designed closed-loop liquid cooling system for workloads where it's needed. Our closed-loop liquid cooling system uses just enough liquid to keep servers from overheating with the least amount of additional energy possible. Between 2021 and 2024, we were able to see our WUE improve by 40%.

One of the projects that I'm the most proud to talk about is Project Rainier in Northern Indiana. That project will be a 2.2 GW data center campus at full buildout. For context, Seattle City Light, our local electric utility serving roughly half a million customers, operates at about 2 GW. So, we're building a data center campus that is the equivalent of Seattle City Light, and yet we will use water for only about 2-3% of the year. So, 97-98% of the time, it runs entirely on outside air for cooling. At full buildout, in an average year, that data center campus might only use a little bit more than the amount of water that can be produced by the local Indiana utility in 12 hours. It's a lot less than some people seem to think.

Tessie: Water use can vary significantly across data center designs and locations. How do the availability and type of water resources in a region factor into how you design and operate a data center?

Brandon: Every region is different. We evaluate climate patterns, local water management and availability, and opportunities to use sustainable water sources. As I said earlier, wherever possible, we work with municipalities to establish sustainable water sourcing strategies, and we prioritize switching from potable water to recycled water, which is treated sewage, to help cool our data centers. That way, we're preserving higher quality water for the communities where we operate.

On top of that, we're also investing in water replenishment and efficiency projects in the regions where we operate. In Mississippi, for example, we're helping farmers adopt precision irrigation technology, which is expected to reduce agricultural water withdrawals by 150 million gallons annually—enough water to supply over 1,600 Mississippi households for an entire year. In Mexico, our water projects are expected to collectively replenish more than 2.5 billion liters of water annually by addressing water loss through aging infrastructure, one of the region's most pressing challenges.

It's completely reasonable for communities to ask us what our water sustainability strategy is and how we plan to use water resources responsibly. And we work to explain to the utilities and local communities how we're leading the way in water use efficiency, and that we will work with the

community to help connect recycled water wherever possible and build high-quality replenishment projects wherever we can.

Tessie: And how is Amazon working to improve water infrastructure and equitable access to water?

Brandon: We're actively building water infrastructure that local communities can use — in Pennsylvania, Atlanta, and in other communities across the country and around the world. For example, in Oregon, we're investing \$235 million in two surface water supply projects that will replace aging infrastructure while helping local communities responsibly conserve groundwater sources. Our investments make up 96% of the total project costs. Amazon data centers will use only about 5% of the combined system capacity, with the remaining 95% serving regional industrial and municipal needs.

And by tapping into Columbia River surface water instead of groundwater aquifers, the project will provide more sustainable water sources for both the broader community and Amazon data centers.

Tessie: Thank you so much for your time today, Brandon. I really appreciate you taking the time to explain Amazon's approach to water and energy.