



Building a responsible, secure and sustainable AI future for Asia Pacific





Embracing the opportunity for Asia Pacific & Japan through the AI revolution

Quint Simon
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At Amazon, we are excited about how artificial intelligence (AI) and generative AI will continue to grow and transform the way we live and work in Asia Pacific & Japan (APJ)¹. At the same time, we are also acutely aware of the potential risks and challenges that this technology presents and the guardrails we need to establish to mitigate them. Our goal at Amazon Web Services (AWS) is to ensure that organizations in APJ can build AI services and solutions responsibly, securely, and sustainably on cloud to harness the power of this truly transformative technology.

New research released from IDC, *The Global Impact of Artificial Intelligence on the Economy and Jobs*, predicts that AI will contribute \$19.9 trillion to the global economy through to 2030, and drive 3.5% of global GDP in 2030. Additionally, every new dollar spent on business-related AI solutions and services in 2030 will generate \$4.60 into the global economy, in terms of indirect and induced effects.

Clearly, this presents a tremendous opportunity for APJ. Realising AI's potential across the region will require a concerted effort to plan and build the right digital infrastructure, drive innovation from organizations of all sizes, provide training to develop skills for now and tomorrow, and deploy risk-based regulatory frameworks. To build a responsible, secure and sustainable AI future in APJ, industry and governments will need to collaborate on the path forward.

Cloud technology is the backbone of the digital economy and a key building block in the generative AI revolution, which economies across APJ are already betting on. AWS has invested billions of dollars into cloud infrastructure in the region, with plans to invest billions more to support the digital and generative AI transformation of our customers.

Furthermore, we are helping our customers transform responsible AI from theory into practice. We offer a range of cutting-edge AI services that have responsibility built in, plus a network of global partners who are accelerating AI applications for customers. It is our belief that responsible development and deployment of AI technologies is key to building the necessary trust in AI, and fostering continued innovation throughout APJ. As AI continues to evolve and mature, we remain committed to developing fair and accurate AI services for organisations across the region, while continuing to work closely with academia, industry, and government partners to help provide a solid foundation for businesses of all sizes to innovate and experiment with AI - safely and responsibly.

Policymakers from across the region are exploring the best ways to balance harnessing the economic benefits of AI, while ensuring the right policies are in place to mitigate potential risks. In Australia, the federal government has begun a comprehensive and collaborative process to regulate the use of AI, with the aim of ensuring that it is developed and used safely and responsibly in government, industry, and beyond. In India, the formation of an advisory group has been announced with the goal of assisting in the development of a framework to regulate AI and help promote innovation, develop guardrails that will protect against misuse and bias, and promote the development of responsible AI. And in Singapore, the Minister for Digital Development and Information announced the introduction of guidelines that will seek to establish a baseline, common standard for generative AI development with a focus on transparency and testing.

At Amazon, we are making sure we are part of these conversations to ensure our customers and partners can continue to innovate at pace with generative AI, and that we don't stifle innovation with cumbersome regulations before we have even begun AI-led economic progress in APJ.

^[1] APJ covers Asia-Pacific and Japan, and does not include the People's Republic of China.



What does responsible AI really mean?

Using AI responsibly is vital if we are to build greater confidence in AI Systems among the region’s citizens and businesses to foster continuous innovation. The public should be confident that these systems are safe, fair, appropriately transparent, privacy protective, and subject to robust oversight. Developing and deploying AI responsibly involves taking a people-centric approach that prioritizes education, science, and our customers, to integrate responsible AI across the end-to-end AI lifecycle.

For Amazon, responsible AI means that the design, development, and deployment of AI must respect the rule of law, human rights, and values of equity, privacy, and fairness. We encourage governments across APJ to require all AI companies to do the same.

Amazon’s AI services account for responsible AI across eight core dimensions:



Fairness:
How a system impacts different subpopulations of users (e.g. by gender, ethnicity)



Safety:
Preventing harmful system output and misuse



Explainability:
Mechanisms to understand and evaluate the outputs of an AI system



Controllability:
Having mechanisms to monitor and steer AI system behavior



Privacy and security:
Appropriately obtaining, using, and protecting data and models



Governance:
Processes to define, implement and enforce responsible AI practices within an organization



Veracity and Robustness:
Achieving correct system outputs, even with unexpected or adversarial inputs



Transparency:
Communicating information about an AI system so stakeholders can make informed choices about their use of the system

While these are our key dimensions today, AI will continue to iterate as the science and engineering of responsible AI matures.

Amazon's perspectives on responsible AI are informed by our dual role as a developer of AI technology and a deployer of AI tools and services. Our focus on AI and ML (machine learning) spans over 25 years. Amazon Web Services (AWS) offers the broadest and deepest set of AI and ML services for cloud customers, while ML drives many of the capabilities customers use when they interact with Amazon.com.

Our practical approach, coupled with the necessary tools and expertise, enables us to offer our customers what they need to implement responsible AI practices effectively within their organisation. To date, we have launched more than 70 responsible AI capabilities and features, more than 500 research papers, studies, and scientific blogs on responsible AI, and completed tens of thousands of training hours on responsible AI for Amazon employees. These guardrails help our customers avoid the concerns most commonly associated with AI.

Businesses across APJ are unfolding plans to build AI responsibly. The practical steps that businesses operating in different sectors need to take, in order to assess and mitigate risks, are neither always clear nor the same. This is particularly true of small- and medium-sized enterprises, which are looking to either experiment or deploy AI but which may be resource-constrained.

Amid this uncertainty, AWS has launched the AWS Responsible Generative AI Community for its customers and partners in Singapore to help customers translate responsible AI from theory into practice. Together, Community members chart specific and practical pathways to develop safe and secure generative AI solutions, leveraging in-house Amazon expertise. This includes a series of one-to-one workshops and biannual meetings with customers and partners who are part of this community of practice.



Amazon Bedrock

Amazon Bedrock, the fully managed service that offers a choice of foundation models for AI development, can implement a series of application-specific safeguards based on customer use cases and responsible AI policies. As a result, it helps customers develop their AI tools and software responsibly. Additionally, AI Service Cards provide transparency and document the intended use cases and fairness considerations for Amazon AI services.

To combat the risk posed by disinformation and deepfakes, images generated by Titan Image Generator contain an invisible watermark that can be validated by an API. This is designed to provide a mechanism to identify AI-generated images. Amazon is among the first to widely release built-in invisible watermarks that are integrated into the image outputs, and designed to be resistant to alteration.

Further safeguards are in play in Amazon SageMaker, the platform that supports developers in building, training, and deploying machine learning models across the complete machine learning lifecycle. Amazon SageMaker Clarify helps mitigate bias by detecting potential bias during data preparation, after model training, and in a deployed model by examining specific attributes. The service provides visibility into model behavior, so customers can provide transparency to stakeholders, inform human making decisions, and track whether a model is performing as intended.

Meanwhile, Amazon SageMaker Model Monitor automatically detects and alerts customers to inaccurate predictions from deployed models, meaning the quality is maintained and misinformation averted. Amazon provides the tools that help customers develop and deploy their AI software in a responsible manner, to the benefit of users and the public.

Promoting Global Collaboration

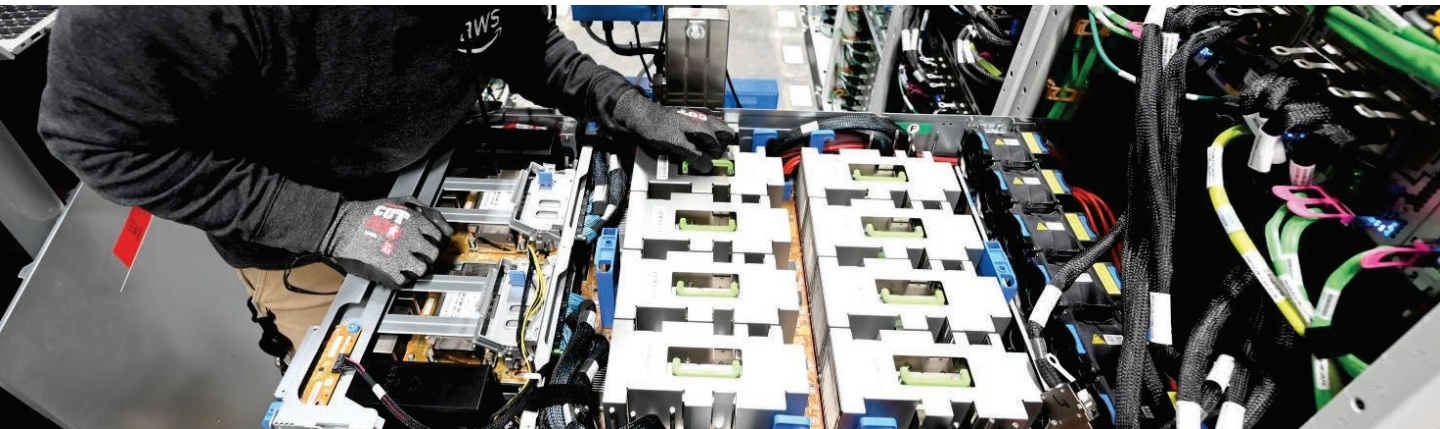
As one of the world's leading developers and deployers of AI tools and services, Amazon supports global initiatives focused on the safe, secure, and responsible development of AI technology.

We are engaged across a number of organizations globally to promote responsible AI, as demonstrated by our involvement with the administration through US National AI Advisory Committee and active participation with the National Institute of Standards and Technology (NIST), the International Organization for Standardization (ISO), the Responsible AI Institute, EqualAI, the Stanford Institute for Human-Centered Artificial Intelligence, Global Partnership on AI, and the Partnership on AI.

In 2023, Amazon endorsed the White House Voluntary AI Commitments, which set out ambitious and concrete

objectives for managing many of the unique risks of powerful generative AI systems, and for building trust with the public, including through red teaming, transparency, mechanisms such as watermarking to disclose AI generated content, and research prioritisation, and we have taken a number of important steps to operationalize these commitments. Amazon also recently joined other industry players in signing the Munich Accord, a voluntary agreement to combat deceptive AI election content.

We took part in robust global collaboration efforts at the G7 AI Hiroshima Process Code of Conduct, and the AI Safety Summits in the U.K. and Seoul, that have laid the groundwork for international interoperability, and we have committed to the important standards and framework that advances and balances innovation and safety.



Promoting International Standards

A key aspect of responsible AI development and deployment is in aligning with international standards. Governments across the APJ region are grappling with many of the same policy challenges, it is vital that countries can align around interoperable policy solutions to the greatest extent possible. Regulatory fragmentation can be a blocker for the adoption of responsible AI – especially for small and medium businesses that are navigating the different regulations.

At the same time, businesses must demonstrate they can confidently mitigate the potential risks of high-risk AI. This can be accelerated through partnerships between industry and government, at regional and global levels. Such partnerships and collaborations can enhance the interoperability of systems, and help actors align on best practices in AI development and deployment. Because many of the opportunities and challenges related to AI are global in nature, it is vital for governments to focus their efforts internationally to ensure alignment, and to influence interoperable policy solutions to the greatest extent possible.

We encourage governments to engage with international standards bodies to support the development of global technical standards, rather than creating entirely standalone domestic standards. From a government perspective, any proposed regulatory requirements should be interoperable with ISO/IEC 42001 for AI Management Systems. ISO 42001 is a comprehensive AI management standard that sets forth an auditable framework for implementing responsible AI goals and commitments.

Effective standards will help reduce confusion about what AI is, what Responsible AI entails, and help to focus the industry on the reduction of potential harms. Amazon is working in a community of diverse international stakeholders to improve AI standards for risk management, including on data quality, bias, and transparency.

Upskilling APJ

A key component in building AI responsibly is education and digital literacy. Amazon has been focused on skill-building for a long time and we know there is a deep need among our customers, partners, employees, and our local communities for solutions to foster a digitally skilled workforce to close global the digital skills gap. Amazon had committed to providing free cloud computing skills training to 29 million people globally by 2025. This goal has already been surpassed and we are at 31 million learners, and within APJ, we have trained more than 8.3 million people with cloud skills since 2017.

As AI continues to evolve and proliferate through the region, we anticipate education to be further integrated with AI technologies. We're focused on making AI, ML, and generative AI skills training and education accessible to everyone through our AI, ML and generative AI skills focused programs and our new 'AI Ready' initiative, a commitment designed to provide free AI skills training to 2 million people globally by 2025. To achieve this goal, we're launching new initiatives for adults and young learners, and scaling our existing free AI training programs—removing cost as a barrier to accessing these critical skills. We offer more than 100 courses and learning resources on AI, ML, and generative AI available through AWS Skills Builder and AWS Educate—our digital learning centres for beginners to advanced learners.

Singapore has made strides towards building an AI-ready workforce. Its National AI Strategy 2.0, released in 2023, set objectives for creating a pool of AI-ready workers, and uplift the entire workforce to use AI tools. In March 2024, IMDA, the digital regulator, scaled its pre-employment training and mid-career upskilling with SG\$20m of investment. This created new AI-related SG Digital Scholarships and overseas internships, and expanded polytechnic programs, with a view to grow the pool of AI practitioners to 15,000 people. This kind of investment will lead to short-term gains in productivity while ensuring that Singapore's workforce remains employable in the long-term.

AWS AI Spring Singapore is a new flagship program that launched in 2024 which aims support Singapore's Smart Nation and National AI Strategy 2.0 goals and further catalyze AI activities, and drive benefits to AWS's customers, partners, and community. As part of the program, AWS signed a MoU with ITE to incorporate AI education into Institute of Technical Education's (ITE) curriculum, with an aim to train 5,000 individuals across institutes of higher learnings, such as universities and polytechnics, on AI skills yearly from 2024-2026. This commitment will help drive the Singapore Government's goal to triple the pool of AI practitioners to 15,000 over five years.



In 2023, Australia's House of Representatives Standing Committee on Employment, Education and Training held an inquiry to explore the risks and opportunities presented by generative AI. Innovations in the field of generative AI are providing new opportunities for educators and education technology companies to reimagine how this technology can improve student success, improve teacher efficiency and impact, and address challenges unique to the education sector. As part of this Inquiry, Amazon advocated for industry to work with the tertiary education sector and appropriate industry partners to co-design and develop digital literacy and technology competency training within the teaching qualification and broader teacher accreditation and professional development frameworks. Through this inquiry, and the Australian Government's ongoing inquiry into ensuring safe and responsible adoption of AI in Australia, we see a unique opportunity to shape an innovation driven future centered around responsibility.

We consistently advocate for governments to enable and promote digital literacy, skilling and responsible use of AI/ML tools among children, students, educators, academic communities, and the wider workforce. Upskilling across APJ is everyone's responsibility and will need strong collaboration between government, industry and educators to help businesses provide AI training programs that make the most of this transformative technology.

Regulation helping to spur innovation

Responsibility and innovation must go hand in hand if we are to build the necessary trust so we can harness the power of these transformative technologies for public good together. Government leaders are trying to balance two sets of interests: 1. they want to ensure that their country is positioned to realize the economic benefits that AI can produce and 2. they also want to make sure that they have the right policies in place to mitigate risks and protect their citizens from any potential harms.

We believe it is important to strike the right balance between innovation and risk mitigation. Over-regulation can have negative impacts on the economy and stifle innovation, which can particularly affect start-ups and small businesses. Small businesses are the backbone of economies across APJ, comprising 97% of all enterprises and employing 69% of the workforce. Freeing up these businesses to innovate will bring the benefits of AI to a huge number of people in the region.

Companies like Amazon will always be at the forefront of progress in AI, and we firmly believe governments should help determine what role AI should play in our societies, our economies, and our lives. We support governments' efforts to put in place effective risk-based and sector-specific regulatory frameworks, and guardrails for AI and ML, while allowing for continued innovation and practical application of the technology.

Shrewd regulation of industries and careful governance will be key to supporting the responsible development and application of AI. A blossoming environment can then emerge that addresses public needs, while ensuring users are protected from risks. This can also provide quick resolution of flaws that appear in AI-generated outcomes.

The question of what good regulation and governance look like will have similar contours across jurisdictions. At their most effective, regulatory frameworks will prioritise vertical, sector-specific regulation, and will put in place risk-based governance.

There have been positive developments in India, where the Ministry of Electronics and Information Technology has created seven working groups to research and establish objectives in an informed manner. The IndiaAI 2023 report, published by the overarching Expert Group, has outlined priorities in upskilling for different aspects of AI development. Recommendations include setting up guidelines, establishing investment mechanisms, and ensuring a conducive environment for AI development and deployment.

Shaping the future of Responsible AI

Establishing the right policy foundation for APJ to develop, deploy and harness the power of AI will be pivotal in ensuring the region is not left behind in the global AI revolution. At Amazon, we believe:

1. Policy makers must ensure to strike the right balance between innovation and risk mitigation. Over-regulation can have negative economic impacts and stifle innovation, which can particularly affect start-ups and small businesses.
2. Governments should adopt a 'vertical', sector-driven approach to AI regulation and governance. The main goal of vertical AI regulation is to address sector-specific issues, ensure safety, and provide tailored guidance for AI applications within a particular industry. It aims to strike a balance between innovation and compliance while addressing industry-specific concerns.
3. Laws or regulations must clearly define and differentiate between high-risk AI applications and those that pose little or no risk. Because the risks associated with AI are also dependent on context, regulations will be most effective when they target specific high-risk uses of the technology.
4. Low risk applications and their widespread adoption provides opportunities for immense productivity gains and, ultimately, improvements in human well-being.
5. Sector-specific regulators should have responsibility for identifying higher risk use cases for their sector against principles-based guidelines. In turn, an AI advisory hub could provide support in identification, enforcement, and monitoring of issues.
6. Citizens across APJ will reap rewards if governments apply sector-specific regulation to allow for continued innovation and practical, effective application of AI and ML technology.



Building AI Securely and Securing AI workloads

Part of a responsible approach to using AI is ensuring that it is secure. For Amazon, security has always been at the heart of everything we do. Strong security must be a focus if businesses across APJ are going to continue experimenting and adopting AI. Our customers will not be able to experience the benefits of AI if they don't feel confident to experiment and explore the technology for themselves, knowing that security is embedded at every step along the way. Whether it's about developing strong security governance practices within an organisation, putting in place the right tools and services to protect AI workloads, or developing a culture of security within an organisation where security is everyone's responsibility, security must be embedded at the core of APJ's AI journey.

Our security culture starts at the top, and it extends through every part of our organization. Security is everyone's job. Instilling an ownership mindset in every developer is the most important thing we can do. We have unparalleled expertise in helping businesses manage security and privacy when developing and deploying generative AI. It can help companies build security into product development. We also provide a wide variety of best practices, documents, encryption tools, and hundreds of tools to help customers meet their security objectives. We build security into our infrastructure and our generative AI stack to protect our customers' data.

Generative AI is transforming the customer experience in industries across the globe. Customers are building generative AI applications using large language models (LLMs) and other foundation models (FMs), which enhance customer experiences, transform operations, improve employee productivity, and create new revenue channels. FMs and the applications built around them represent extremely valuable investments for our customers. They're often used with highly sensitive business data, like personal data, compliance data, operational data, and financial information, to optimize the model's output.

Amazon's own Chief information security officer (CISO), Chris Betz:

"The biggest concern I hear from customers as they explore how to adopt generative AI is how to protect their data as well as the data of their end-customers. From day one, our AI infrastructure and services have had built-in security and privacy features to give customers control over their data.

Our [AWS Nitro System](#) plays a key role here. Nitro's specialized hardware and associated firmware enforce restrictions so that nobody, including anyone at Amazon, can gain logical access the underlying infrastructure, workloads, or data running on customers' Amazon Elastic Compute Cloud (Amazon EC2) virtual servers."

Our customer's data is incredibly valuable. They require it to stay protected, secure, and private, and we have designed our AI stack to fulfil their request. Our top priority is safeguarding the security and confidentiality of our customers' workloads. We think about security across the three layers of our generative AI stack, to ensure security at all phases:

- Bottom layer – Provides the tools for building and training LLMs and other FMs.
- Middle layer – Provides access to all the models along with tools you need to build and scale generative AI applications.
- Top layer – Includes applications that use LLMs and other FMs to make work stress-free by writing and debugging code, generating content, deriving insights, and taking action.

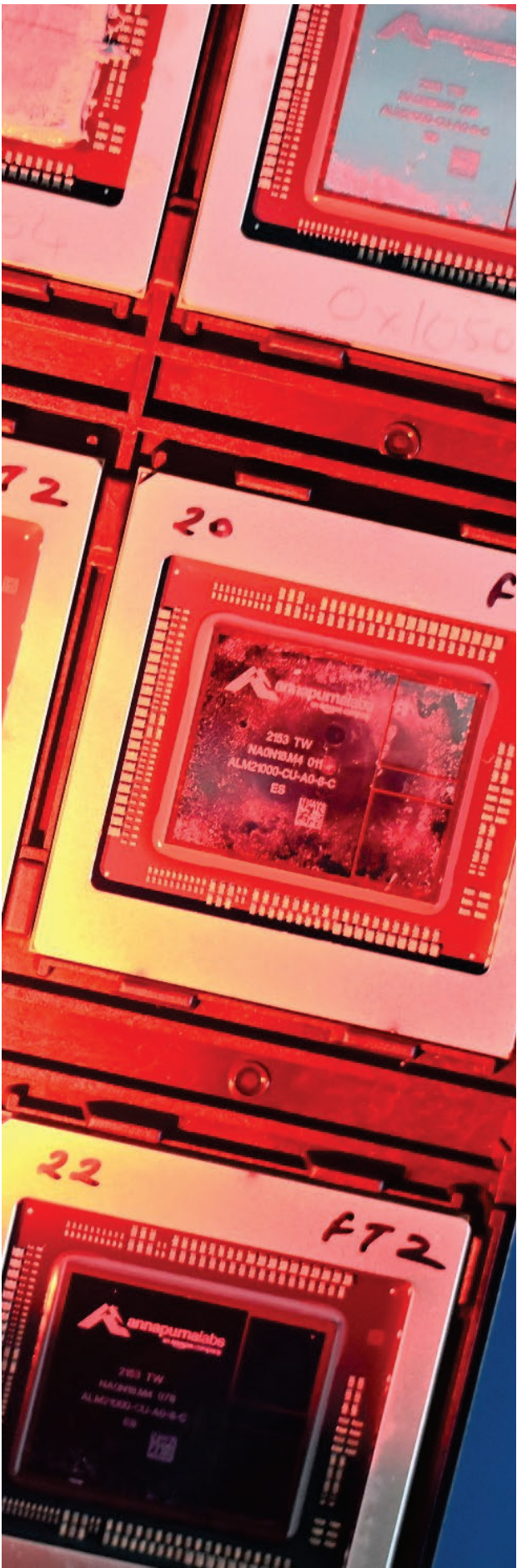
Each layer is important in making generative AI pervasive and transformative. It is important to note that Amazon, as the infrastructure operator, has no ability to access customer content and AI data, such as AI model weights and data processed with models. We also provide mechanisms for customers to isolate AI data from themselves and protect infrastructure communications.

Our customers can harness AI in a secure way, and this means tapping into a ready-made culture of security, and implementing strong security hygiene practices. We recommend that everyone adopts some form of multi-factor authentication (MFA), and encourage customers to choose forms of MFA that are phishing-resistant, such as security keys. For example, users can enable multiple MFA options, including passkeys and authenticator apps. Encryption also helps ensure data is protected at all times. Amazon takes the extra step of offering encrypting data-at-rest and data-in-transit, as well as offering multiple services for client-side encryption. Our customers own and control their data, including where it is stored, how it is stored, and who has access. Customers can use the array of Amazon services to implement a comprehensive data at rest and data in transit encryption strategy.

It remains vital for regulators to ensure continued regulatory interoperability through alignment to international standards such as the ISO 27090. This standard is being developed to help all kinds of organisations understand the consequences of security threats to AI systems throughout their lifecycle. As a result, alignment with this ISO supports responsible and secure AI development and deployment.

Amazon has always been secure by design, defining industry-leading practices, technologies, and controls that are deeply integrated across all layers, from the physical data centres to the network design, and service architectures, ensuring robust security and data protection for customers' applications and data. We have a dedicated team of generative AI and security experts that have developed security testing and controls for all our AI models and services. Adopting robust security hygiene practices will ensure speed of innovation, security and a confident workforce ready to adopt securely.

A [study](#) by the Australian Alliance for Artificial Intelligence in Healthcare has shown how important data security can be, to effectively mobilize AI-driven productivity gains in the critical and sensitive healthcare sector. Robust data security is key to winning the trust of stakeholders across the environment, including patients. The Alliance argue that if there is a lack of trust in AI technologies, then individuals and organizations are less likely to use AI widely and effectively – stymying potential productivity gains. Such gains could then be used to offset healthcare staff's time to other key activities, leading to better outcomes all round.





Securing AI through policy development

When considering whether new regulation is needed for AI security, policymakers should focus on whether the use of AI adds new risks beyond those risks already present when AI is not in use. Where existing laws are insufficient to address specific AI risks or otherwise create uncertainty about the application of AI, lawmakers should generally amend existing applicable requirements rather than creating a separate framework for securing AI.

Legislative initiatives need to appreciate the full range of AI/ML so that trying to regulate all AI/ML applications with the same approach is impractical and can have the effect of stifling innovation.

Security regulations are most effective when they take a risk-based approach and target specific high-risk uses of the technology. This is particularly effective when considering AI security because the risks associated with AI are highly dependent on context.

Once a business has identified an area where AI will help them achieve their goals, we've found that there are three big questions security practitioners should be asking. Working through these will help organizations align the security needs for their business workflow.

1. The first question to ask is, "Where is our data?"

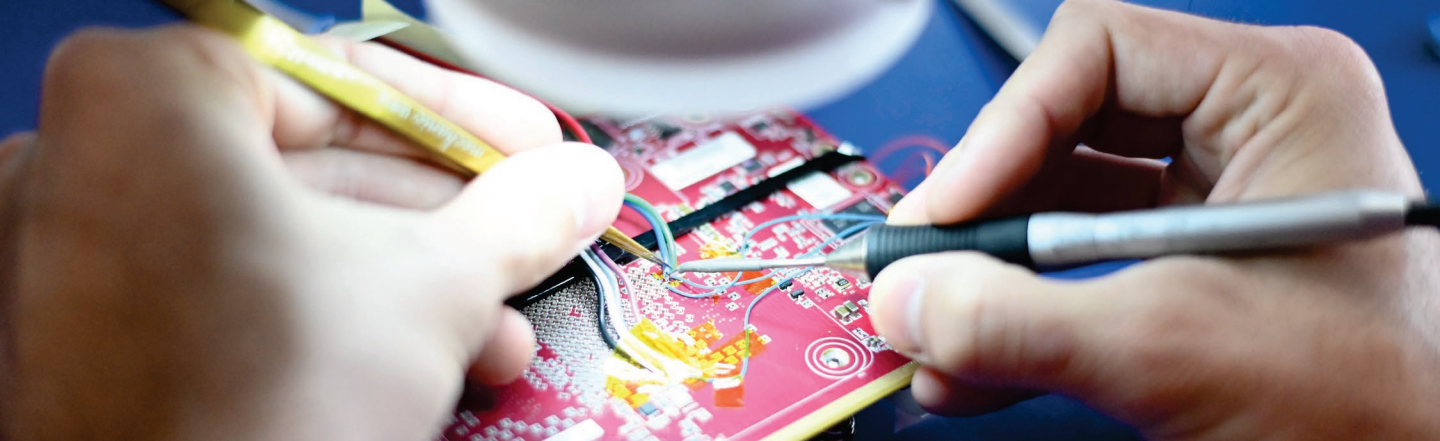
Business teams are sending data to an LLM for processing, either for training to help build and customize the model or through the queries of that model. How is that data handled throughout that workflow and how is it secured? We know that, in general, the more data a model has to consider, the better the outcome.

2. The next question to ask is, "What happens with my query and any associated data?"

Training data isn't the only sensitive dataset you need to be concerned about. When users start to embrace generative AI and LLMs, they quickly learn what makes an effective query. They start adding more details and specific requirements to their query which leads to better results.

3. If your user queries an AI, is the output from that query and the user's reaction to the results used to train the model further? What about the file that the user submitted as part of the query? The way a service handles that data is a question you need answers to.

The query itself can also be sensitive and should be part of your data protection plan. There's a lot you can infer from a question that a user asks.



Building AI Sustainably

As our society relies on technology more than ever, global energy demands are growing, including due to the use of AI. We believe AI holds the potential to help us address and solve sustainability challenges at the speed and scale that climate change demands.

Amazon has almost two decades of experience building and operating infrastructure to meet our customers' evolving needs. We're constantly re-evaluating how our data centres operate and determining ways to help them run on less energy and be more efficient.

As we scale our use of AI, it's important to also minimize its environmental footprint. While we're proud of achieving our 100% renewable energy goal seven years early in 2023, we know there's more work to be done as we continue to focus on our Climate Pledge commitment to be net-zero carbon by 2040.

A new study commissioned by Amazon and conducted by Accenture shows that an effective way to do that is by moving IT workloads from on-premises infrastructure to Amazon data centres around the globe. The results show that running compute-heavy AI workloads on Amazon in APJ is up to 3.2 times more energy-efficient than on-premises, and can reduce

"This research shows that Amazon's focus on hardware and cooling efficiency, carbon-free energy, purpose-built silicon, and optimized storage can help organisations reduce the carbon footprint of AI and machine learning (ML) workloads. As the demand for AI continues to grow, sustainability through technology can play a crucial role in helping businesses meet environmental goals while driving innovation."

Sanjay Podder
Global lead for Technology
Sustainability Innovation at Accenture.

the associated carbon footprint by up to 97% when optimized. Considering 85% of global IT spend is still on-premises, there is tremendous opportunity for enterprises and other organizations to reduce their IT related carbon footprint by migrating to Amazon and then further optimizing workloads to reduce it further.

The efficiency gains associated with Amazon, identified by Accenture, are primarily due to Amazon's continuous focus on efficiency across all aspects of our infrastructure, from the design of our data centres and hardware, to modelling the performance of our operations for continuous enhanced efficiency, we work to reduce the amount of energy needed to operate our data centres. Amazon is also making progress toward transitioning to carbon-free energy, reducing embodied carbon, committing to being water positive by 2030, and adopting circular economy practices.

One of the most visible ways Amazon is innovating for energy efficiency is through the company's investment in Amazon chips. Launched in 2018, the custom Amazon-engineered general-purpose processor, Graviton, was the first-of-its-kind to be deployed at scale by a major cloud provider. The latest Graviton4 offers four times the performance of Graviton1, and while Graviton3 uses 60% less energy for the same performance as comparable Amazon EC2 instances (where the compute happens in a data centre), Graviton4 is even more energy efficient.

Amazon customers are also benefiting from the carbon reduction potential of Graviton. Paytm, India's leading payments and financial services distribution platform, witnessed a reduction in workload carbon intensity by adopting Graviton processors, reporting up to 47% estimated decrease in carbon emissions per transaction. SK Telecom faced difficulties in addressing the increasing data scale and analysis performance issues in an on-premises environment while building TANGO (T Advanced Next Generation OSS), a next-generation AI network management system. To address this, SK Telecom utilized Amazon Graviton instances, optimized for large-scale data processing and AI/ML workloads, to build the TANGO solution. As a result, Amazon contributed to reducing the carbon emissions of SK Telecom's TANGO solution workloads by approximately 27% compared to on-premises.

While there is truth to more intense energy needs to train Large Language Models (LLMs) and perform AI workloads, the worst of the data centre energy projections have also historically been proven wrong. For example, according to the IEA, even though data centre workloads increased [more than six-fold](#) between 2010 and 2020, energy consumption remained relatively flat due to vast improvements in energy efficiency by data centre operators.

At Amazon, we're further improving energy efficiency with fundamental changes to our data centre design, from optimising the longevity and airflow performance of the cooling media in our data centre cooling systems, to use of advanced modeling methods to understand how a data center will perform before it's built. It is still early days for AI and generative AI and we are confident we will see more innovations from data centres to continuously improve energy efficiency.

The remainder of the emissions reduction opportunity for customers migrating workloads to AWS comes from AWS's commitment to using 100% carbon-free electricity. In 2019, we set a goal to match all of the electricity consumed across Amazon's global operations—including our data centres, corporate buildings, grocery stores and fulfilment centres—with 100% renewable energy by 2030. Amazon is proud to have met that goal seven years ahead of schedule. All of the electricity consumed by Amazon's global operations, including its data centres, was matched with 100% renewable energy in 2023.

To get there, Amazon has become the largest corporate purchaser of renewable energy in the world for four years running, and holds the same title in India and Japan. Amazon has invested billions of dollars in more than 500 solar and wind projects globally, which together are capable of generating enough energy to power the equivalent of 7.6 million U.S. homes. In Asia Pacific, Amazon has enabled more than 80 renewable energy projects with a combined estimated capacity of over 2.2 gigawatts.



While we'll continue investing heavily to add substantial amounts of renewable energy to our portfolio, we're also exploring new carbon-free energy sources that can complement renewables and balance our needs.

An important part of Amazon's renewable energy investments includes work to improve the grid, which needs to be modernized in order to deliver energy from new solar, wind and other carbon-free energy projects to users. According to the International Energy Agency (IEA), the world must add or replace 80 million kilometres of grids by 2040 to meet climate targets, and more than 1,500 GW of renewables projects are waiting in the queue globally.

To help address this, teams across Amazon are engaging with energy regulators to find new ways to support grid modernization, remove permitting obstacles, and deploy grid enhancing technologies. We also co-founded the Emissions First Partnership, a coalition of energy purchasers focused on encouraging renewable energy investments in regions with grids that are primarily fuelled by fossil fuel energy sources.

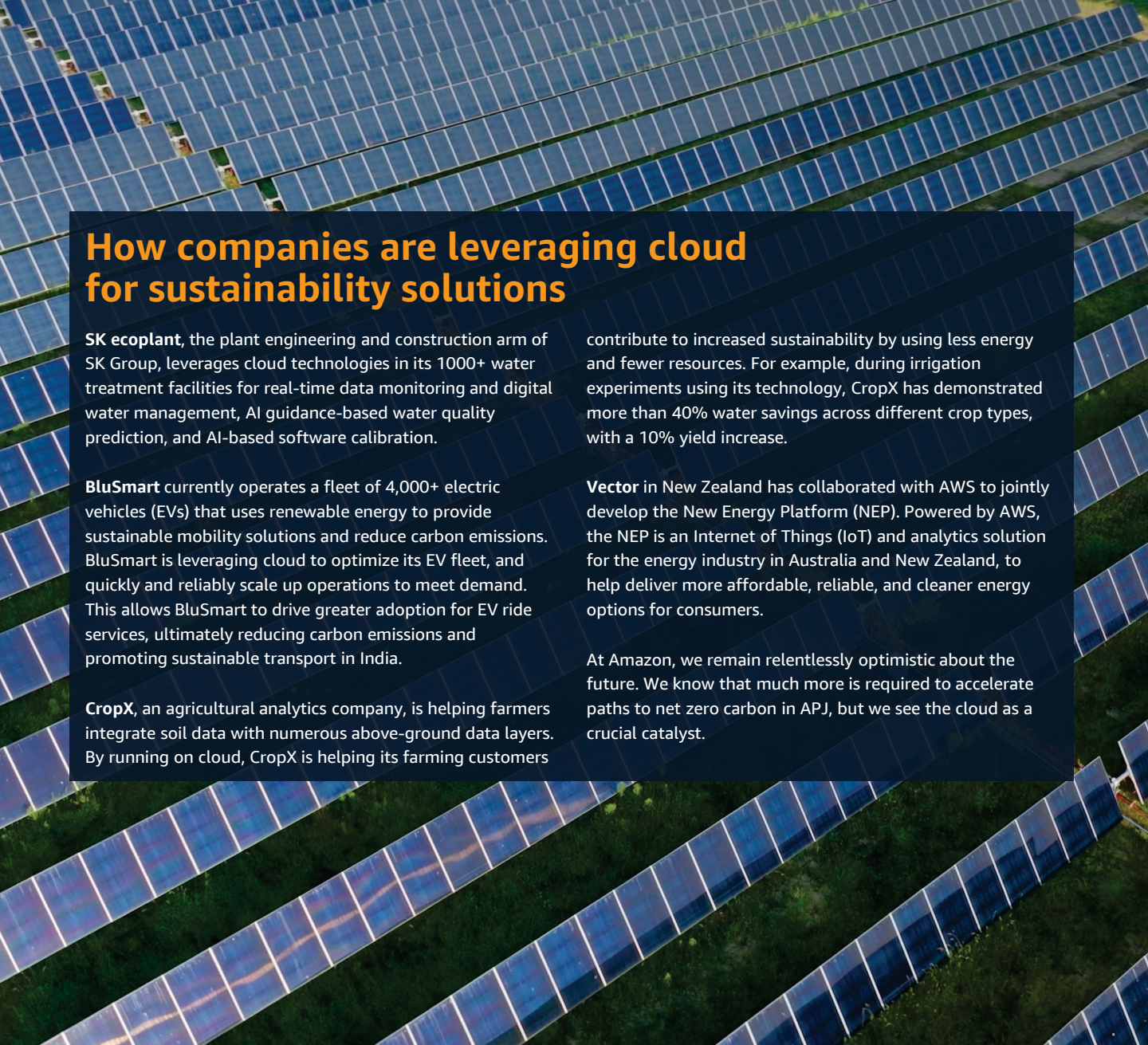
Grid-enhancing technologies accessible on cloud are a great option for making existing power grid infrastructure smarter, with increased capacity, flexibility, and resiliency, all of which also helps relieve congestion and avoid increased costs for ratepayers.

For example, [Greenko](#) has migrated real-time data from its entire fleet of over 2,000 wind turbines generating 3.2 GWs of wind power in India onto the cloud, resulting in consolidated operational monitoring, reduced operating expenses, and AI-ready data.

Amazon pays transmission costs at rates established by utility regulators to make sure we are paying for the costs of the electricity we use. Transmission charges fund the ongoing grid modernization and upgrades required to support the needs of all energy users. Utility regulators set these transmission charges to make sure buyers pay their fair share.

We work closely with utilities and grid operators to plan for future growth. Where we require specific infrastructure to meet our needs (such as new substations), we work to make sure that we're covering those costs and that they aren't being passed on to other ratepayers. We're also working with utilities on innovative new agreements to keep rates comparably low and bring net-new carbon-free energy projects to the grid.

Finally, we should not forget about the innovative power of cloud technologies and AI in developing sustainability solutions for today and tomorrow. According to the [International Energy Agency](#), cloud-enabled technologies—such as artificial intelligence (AI), machine learning (ML), Internet of Things (IoT) and edge computing—will be critical to accelerating systemic transformations at scale. We are already witnessing [climate tech start-ups leverage generative AI to address the climate crisis](#), and Amazon continues to [innovate with AI to build a more sustainable future](#).



How companies are leveraging cloud for sustainability solutions

SK ecoplant, the plant engineering and construction arm of SK Group, leverages cloud technologies in its 1000+ water treatment facilities for real-time data monitoring and digital water management, AI guidance-based water quality prediction, and AI-based software calibration.

BluSmart currently operates a fleet of 4,000+ electric vehicles (EVs) that uses renewable energy to provide sustainable mobility solutions and reduce carbon emissions. BluSmart is leveraging cloud to optimize its EV fleet, and quickly and reliably scale up operations to meet demand. This allows BluSmart to drive greater adoption for EV ride services, ultimately reducing carbon emissions and promoting sustainable transport in India.

CropX, an agricultural analytics company, is helping farmers integrate soil data with numerous above-ground data layers. By running on cloud, CropX is helping its farming customers

contribute to increased sustainability by using less energy and fewer resources. For example, during irrigation experiments using its technology, CropX has demonstrated more than 40% water savings across different crop types, with a 10% yield increase.

Vector in New Zealand has collaborated with AWS to jointly develop the New Energy Platform (NEP). Powered by AWS, the NEP is an Internet of Things (IoT) and analytics solution for the energy industry in Australia and New Zealand, to help deliver more affordable, reliable, and cleaner energy options for consumers.

At Amazon, we remain relentlessly optimistic about the future. We know that much more is required to accelerate paths to net zero carbon in APJ, but we see the cloud as a crucial catalyst.

The future of sustainable AI

Clearly, there is so much decarbonization potential with cloud technology, and there are actions we can start taking now. Governments in the region can:

Ensure that AI workloads are run in the most efficient environment possible, which is cloud technology. This includes private and public sector collaborating to raise awareness on the sustainability gains of migrating workloads to cloud.

Encourage a cloud-first approach for digitalization and IT needs in the country to maximize the decarbonization potential from the beginning.

Remove barriers to cloud adoption to help accelerate sustainability innovation. Regulated industries, such as

energy, financial services, and telecommunications, present some of the greatest opportunities for scaling sustainable solutions, given their society-wide reach. But they also face regulatory barriers to greater use of cloud computing.

Develop enabling policies to encourage greater investment in additional renewable energy projects, facilitate greater use of existing renewable power assets, and bolster connectivity for new ones.

Collaborate with cloud providers, energy companies and utilities to accelerate grid modernization and planning to secure our collective energy future.