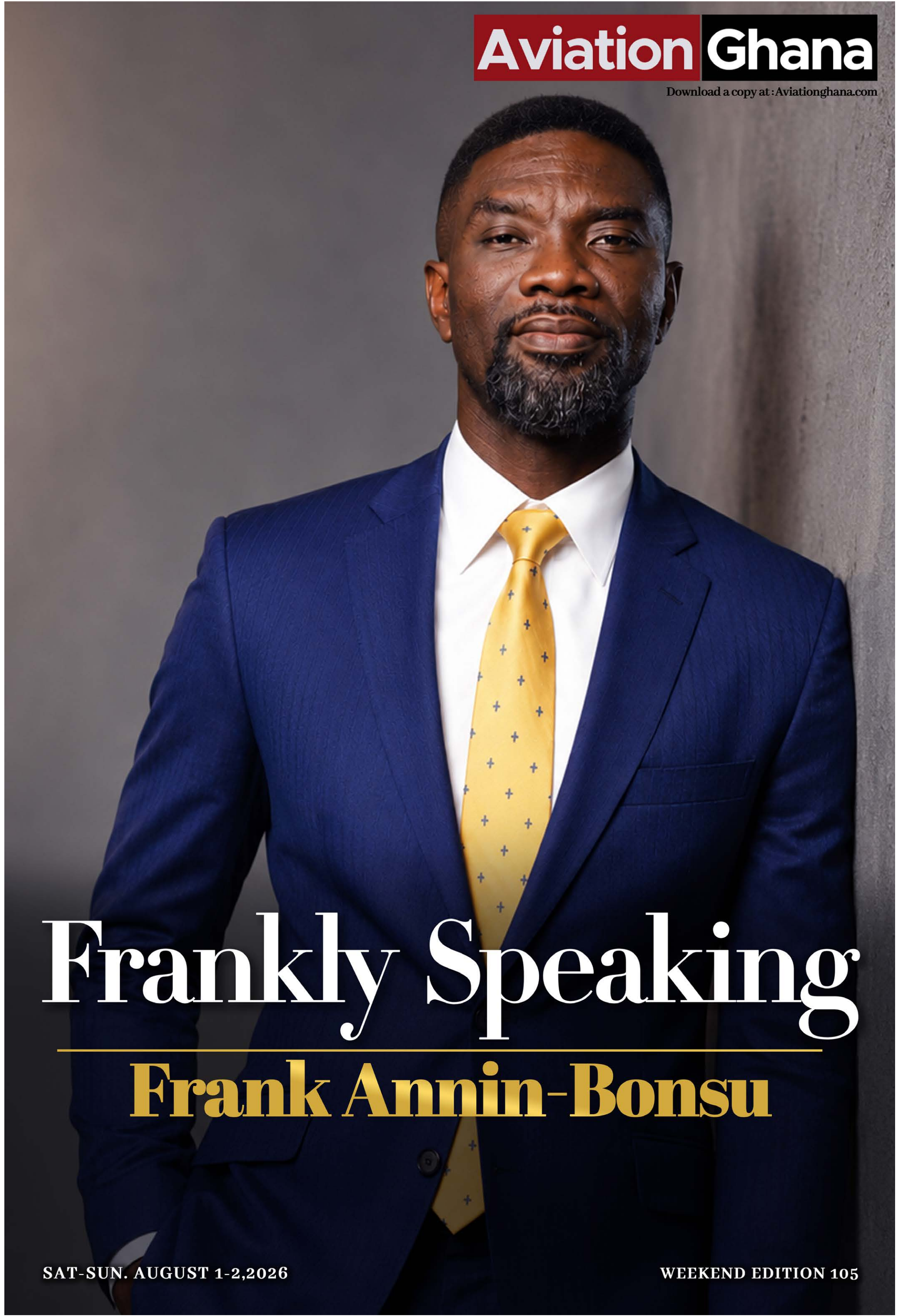


A portrait of Frank Annin-Bonsu, a Black man with a beard, wearing a dark blue suit, white shirt, and a yellow tie with a small dark cross pattern. He is standing against a grey, textured wall.

Frankly Speaking

Frank Annin-Bonsu

Frank Annin-Bonsu: Frankly Speaking



“Success in travel is not measured by the number of tickets sold but by the number of lives connected, careers built, and opportunities created.” That philosophy has defined the remarkable career of Frank Annin-Bonsu, Chief Executive Officer of Josh Travels & Tours, whose influence now extends far beyond the walls of his thriving travel management company.

Today, he is recognised not only as one of Ghana’s leading travel professionals but also as a respected industry advocate, educator and mentor whose work continues to shape the country’s aviation and travel ecosystem.

For more than three decades, Annin-Bonsu has dedicated his professional life to one

mission—making travel easier, more professional and more valuable to businesses, governments and individual travellers.

From Humble Beginnings to Industry Leadership

Every successful entrepreneur has a defining story, for Frank Annin-Bonsu, that story began with a dream rather than a large office or significant capital.

When he founded Josh Travels Limited in 2012, the company operated from his residential apartment. Like many entrepreneurs, he started with determination, experience and an unwavering belief that quality service would eventually distinguish his business from the competition. It did.

More than a decade later, Josh Travels has grown into one of Ghana’s most respected travel management companies, serving corporate organisations, government institutions, development partners and individual travellers.

The company’s tenth anniversary in 2022 was more than a business milestone, it symbolised resilience, disciplined leadership and a relentless pursuit of excellence. Behind that growth has been Annin-Bonsu’s quiet but consistent commitment to professionalism.

Perfecting the Art of Travel Management

Long before establishing Josh Travels, Frank Annin-Bonsu had already accumulated

decades of experience within Ghana’s travel industry.

With more than 25 years spent mastering airline reservations, corporate travel management, destination planning and customer service, he developed an understanding that modern travel agencies are no longer simply ticket sellers, they are strategic travel advisors. Corporate travel today requires cost optimisation, risk management, visa advisory services, itinerary planning, emergency response and round-the-clock customer support.

Annin-Bonsu understood this evolution early and positioned Josh Travels accordingly. His approach transformed the company into a comprehensive travel management partner rather than a traditional agency. That philosophy continues to define Josh Travels today.

Leading Ghana’s Travel Agency Community

While many business leaders concentrate solely on growing their own companies, Frank Annin-Bonsu chose a different path.

As President of the Ghana Association of Travel and Tour Agencies (GATA), he has become one of the strongest voices advocating for Ghana’s travel trade.

Representing many of the country’s leading accredited travel agencies, GATA occupies a strategic position between airlines, regulators, airports and government.

Under Annin-Bonsu’s leadership, the Association has consistently championed policies that recognise travel agencies as indispensable partners within Ghana’s aviation value chain.

Continue on Page 04

Welcome Kano



Continued from Page 2

He has argued that airlines cannot thrive without professional distribution networks capable of connecting passengers with destinations efficiently and responsibly.

His advocacy has increasingly focused on ensuring that aviation policy adequately supports the travel agency sector, recognising that travel consultants contribute significantly to tourism growth, airline sales and national economic development.

Speaking publicly on industry challenges, Annin-Bonsu has repeatedly called for policies that better reflect the realities facing Ghana's travel businesses, emphasising that travel agencies remain critical enablers of aviation growth.

Championing Integration Across the Aviation Value Chain

One of Annin-Bonsu's enduring contributions has been his belief that aviation extends far beyond airports and airlines. For him, the aviation ecosystem includes travel consultants, tour operators, hospitality providers, immigration professionals, tourism authorities, educational institutions and technology providers.

This integrated perspective has informed much of his leadership within GATA. He has consistently advocated closer collaboration between airlines and travel agencies, arguing that stronger partnerships ultimately benefit passengers through better service, wider distribution and enhanced customer support.

His vision aligns with broader continental efforts under the African Continental Free Trade Area (AfCFTA), where improved air connectivity and seamless travel are increasingly viewed as drivers of regional integration.

Building People, Not Just Businesses

Perhaps Frank Annin-Bonsu's most enduring legacy may not be Josh Travels itself, it may be the people he trains. Recognising the growing demand for skilled

professionals across aviation, hospitality and tourism, he established the Josh Training Institute Hospitality and Aviation at No. 6 Odanta Street, Asylum Down, Accra. The institution reflects his conviction that Ghana's travel industry requires continuous professional development if it is to compete internationally.

Rather than waiting for the next generation of travel professionals

Service

Those who know Frank Annin-Bonsu describe him as approachable yet disciplined. He leads without unnecessary noise. Instead, he prefers consistency. His management philosophy centres on teamwork, customer satisfaction and ethical business practices. That approach has earned Josh Travels a reputation for reliability within Ghana's corporate travel market.



to emerge naturally, he decided to help create them. The institute provides practical training designed to prepare young Ghanaians for careers in aviation, travel, tourism and hospitality. It is a natural extension of his lifelong commitment to learning.

Those who work with him often describe him as someone who never stops improving himself. That same culture of continuous learning has become embedded within Josh Travels, where staff development remains a central part of the company's philosophy.

A Leadership Style Built on

Clients know they are dealing with professionals who understand that every itinerary represents a business opportunity, a family reunion, an educational journey or a life-changing experience. Travel, after all, is ultimately about people, and Frank has never lost sight of that simple truth.

Preparing Ghana for the Future of Travel

The global travel industry continues to evolve rapidly. Artificial intelligence, digital booking platforms, biometrics, sustainability and changing consumer behaviour are

reshaping how travellers plan journeys. Yet even as technology advances, Frank believes knowledgeable travel professionals remain essential. "Technology may process bookings faster, experienced consultants provide judgment, reassurance and solutions when travel plans change unexpectedly. That human element remains irreplaceable," he says.

His investment in training reflects confidence that future travel professionals will need both digital competence and interpersonal skills.

A Legacy Still Being Written

Frank Annin-Bonsu's story is not simply one of entrepreneurial success, it is a story of institution building. From growing Josh Travels into one of Ghana's leading travel management companies to leading GATA through periods of industry transformation, and from advocating for travel agencies to investing in aviation education, his influence now reaches every corner of Ghana's travel ecosystem.

His journey demonstrates that leadership is measured not only by commercial success but also by the ability to strengthen an entire industry.

As Ghana's aviation and tourism sectors continue to expand, the country will need experienced professionals willing to mentor others, shape policy and prepare future generations for careers in travel.

Frank Annin-Bonsu has already embraced that responsibility. Through Josh Travels, the Josh Training Institute-Hospitality and Aviation, and his leadership of GATA, he continues to help chart the future of Ghana's travel industry one journey, one student and one professional at a time.

In an industry built on connecting people and places, few have connected as many opportunities for others as Frank Annin-Bonsu. His career stands as a testament to perseverance, professionalism and the enduring value of investing in people.



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2nd - 3rd July, 2026

SESSIONS

Morning session 9:00 AM - 11:00 AM

Afternoon session 12:00 PM - 2:00 PM

Evening session 3:00 PM - 5:00 PM



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Washington Dulles International Airport To Get \$20 billion makeover

By Prince Offeh



The Metropolitan Washington Airports Authority, United Airlines and the U.S. Department of Transportation today announced a landmark transformation for Washington Dulles International Airport with a capital investment program of more than \$20 billion. The project will transform the airport over the next decade into a modern, world-class gateway reflecting the importance and global reach of the nation's capital and enhancing the experience for millions of travellers.

The Airports Authority and United will partner on this transformation to reshape many aspects of the Dulles journey, with new and modernised facilities designed to create a smoother, more efficient and elevated experience from curb to gate, while preserving architect Eero Saarinen's iconic Main Terminal design.

"This new construction effort builds upon the multiyear Dulles Master Plan, developed in consultation with our airline partners, that will modernise Washington's main international airport," Airports Authority President and CEO Jack Potter said. "We are grateful for the Trump administration's interest in accelerating the pace and scope of our plans, and we look forward to building new facilities that will be a source of pride for our nation."

Travellers can look forward to more than 5 million square feet of new or renovated space, including new and modernised concourses, an expanded and enhanced Main Terminal with more walkable access to gates, and new train service connecting the airport that will retire Dulles' mobile lounge vehicles.

"Washington Dulles is the gateway that connects the nation's capital to the world, and this transformation builds on United's long-term investment in our hub to deliver the world-class airport experience our employees, customers and millions of travellers deserve," said United CEO Scott Kirby. "We thank the Trump administration and the Department of Transportation for their support as we move this transformative project forward and make Dulles a showcase for the nation's capital, setting a new standard for airports across the country."

"President Trump's work to make D.C. safe and beautiful has already reshaped our nation's capital for the better. But to truly achieve this vision, we need to build an international gateway that is worthy of the greatest country on earth," said U.S. Transportation Secretary Sean P. Duffy. "By partnering with United Airlines and MWAA, we will create a world-class airport filled with stunning architecture, gorgeous concourses, efficient security screenings, additional gates, and improved mobility – all while

preserving Dulles' iconic primary terminal. Say goodbye to those stale concourses, drab interior, endless walkways, and those absurd mobile lounges, and say hello to a state-of-the-art facility that will inspire millions of flyers for generations to come."

Bringing the Future to Dulles

The transformation will occur in phases over several years, with the Airports Authority, United and other airlines and airport partners working together to move construction forward while Dulles continues to operate safely and reliably for travellers.

Dulles' transformation stems from a December 2025 request for information issued by the U.S. Department of Transportation seeking proposals to modernise the airport and better position it for future growth. The construction program follows an extensive government review of more than 30 proposals submitted in response to the request for information and accelerates a capital improvement program already underway as part of the Airports Authority's Master Plan and an earlier agreement with the airlines.

While Dulles' transformation will benefit all airlines and travellers at Dulles, it also builds on United's continued growth and long-term investment in its Washington Dulles hub. United, as the largest

airline in the D.C. region, and the Airports Authority, as the operator of the Washington region's major airports, will closely collaborate on the development and execution of the enhancements to help create a Dulles Airport worthy of the nation's capital.

"The massive upcoming project at Dulles — one of Virginia's most important gateways to the rest of the world — will bring new opportunities not just to Northern Virginia, but to the Commonwealth as a whole," said Governor Abigail Spanberger. "This expansion means new jobs for Virginians, new tools to bring more business investment to our Commonwealth, and new infrastructure improvements to make sure Dulles remains a world-class international airport for generations to come. I look forward to welcoming even more travellers to experience all that our Commonwealth has to offer."

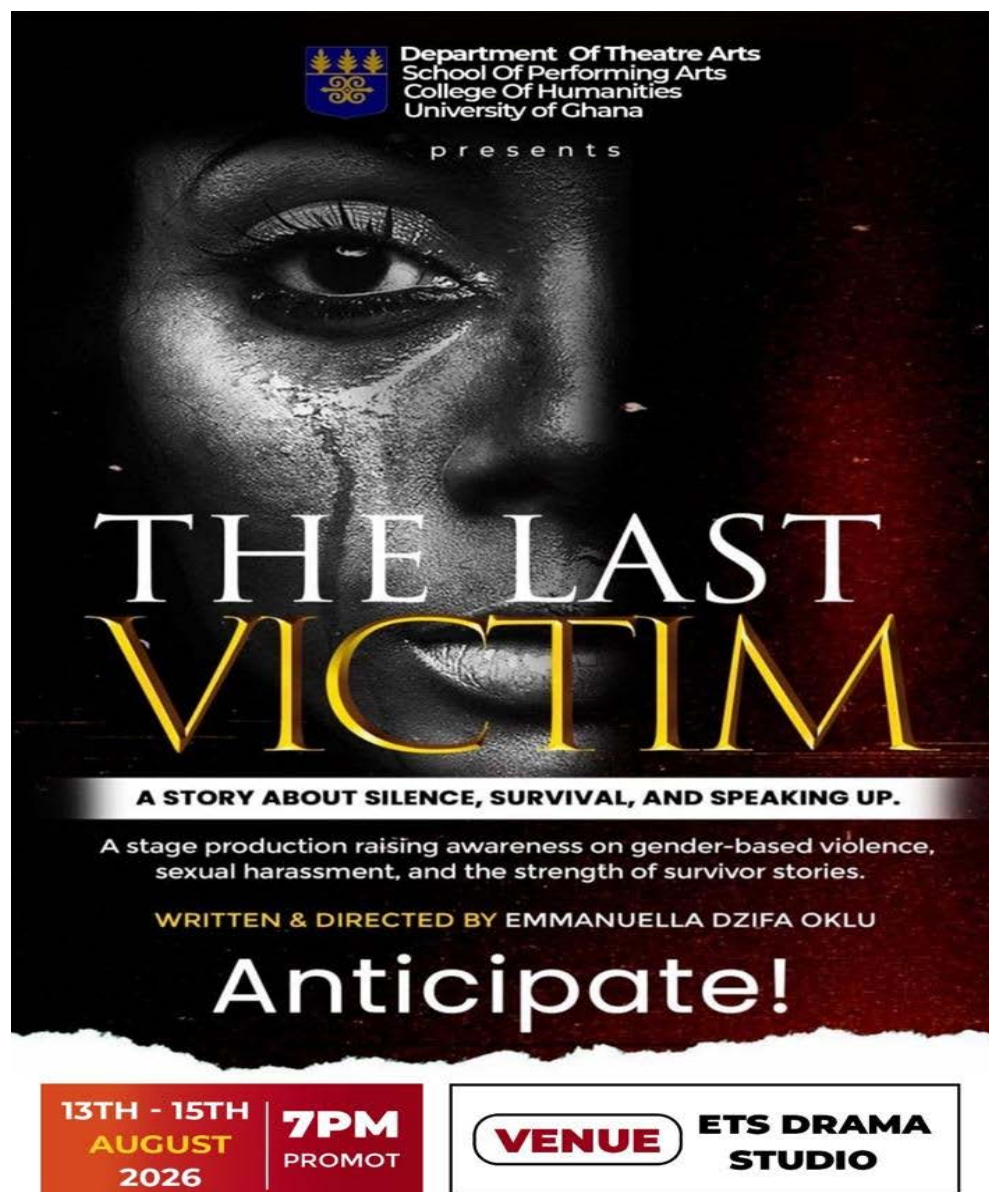
Supporting the Next Era of Dulles
The investment of more than \$20 billion represents a significant increase over the \$7 billion previously allocated for the Dulles modernisation program. The Airports Authority, working with airlines serving Dulles, will finance much of the project through municipal bonds, which offer significantly lower interest rates than bonds available to private-sector firms.

When complete, the transformation will deliver an airport experience that reflects Dulles' role as the country's premier gateway to the nation's capital for millions of travellers each year.

Significant modernisation work is already underway. Later this year, the new Concourse E will open with 14 new United gates that will help the airline expand its international network, provide direct access to the airport's AeroTrain system, and debut new and enhanced passenger lounges.

The Last Victim

By Priscilla Frimpong & Gloria E. Yanney



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In a society where many survivors of abuse continue to suffer in silence, theatre remains one of the few artistic spaces capable of transforming private pain into public conversation. This August, the Department of Theatre Arts at the School of Performing Arts, University of Ghana, will present *The Last Victim*, a stage production that seeks not only to entertain but to challenge, educate, and provoke reflection on one of society's most pressing issues: gender-based violence and sexual abuse.

Written and directed by University of Ghana student Emmanuella Dzifa Oklu, the upcoming stage production confronts gender-based violence, survival, and the courage to speak out. Dzifa Oklu's *Last Victim* will run from August 13 to 15, 2026, at 7:00 p.m. each evening at the ETS Drama Studio. Described as "a story about silence, survival, and speaking up," the production arrives at a time when conversations around abuse, victimhood, institutional accountability, and healing continue to shape public discourse both in Ghana and across the globe.

At its core, *The Last Victim* tells the story of survivors breaking their

silence.

According to the production's synopsis, the play follows five women carrying deep emotional wounds who emerge from darkness to confront a painful realization: "We know this story." One by one, they recount experiences of abuse perpetrated by individuals who should have protected them; uncles, stepfathers, husbands, trusted religious leaders, and family members. Through their testimonies, the play explores how power, familiarity, and silence can become instruments of harm.

Yet, *The Last Victim* deliberately refuses to remain a story of victimhood alone.

Instead, it charts a journey toward agency, resistance, and survival. The survivors reclaim ownership of their narratives, declaring: "We are not the story they tried to write on us. We are the ones who survived the writing." It is this transition from silence to voice, from pain to resistance, that appears to form the emotional backbone of the production.

Theatre, Mirror Of Society

For centuries, theatre has served as one of humanity's most powerful

tools for confronting uncomfortable truths. Unlike film or television, live theatre places audiences in immediate proximity to human experience, creating an emotional intimacy that can be difficult to replicate elsewhere.

In Ghana, theatre has historically played a critical role in social education and advocacy. From the pioneering works of Efua Sutherland to contemporary productions addressing governance, corruption, mental health, and social justice, the stage has consistently functioned as a space where difficult conversations can unfold safely yet powerfully.

Productions that address gender-based violence occupy a particularly important place within this tradition. According to various national and international studies, many cases of abuse remain underreported due to fear, stigma, social pressure, and lack of institutional trust. Artistic interventions, including theatre, have increasingly become vital platforms for raising awareness, fostering empathy, and encouraging public dialogue.

By bringing stories of abuse survivors into a communal space, *The Last Victim* challenges audiences to move beyond statistics and headlines and instead encounter the emotional realities that often remain hidden behind them.

The significance of *The Last Victim* lies not only in its subject matter but also in its perspective.

As a student-led production emerging from one of Ghana's foremost theatre institutions, the play represents a younger generation of artists choosing to engage directly with complex social issues. Rather than avoiding uncomfortable conversations, writer and director Emmanuella Dzifa Oklu appears to embrace theatre's potential as both an artistic and civic responsibility.

The production emphasis on institutions, including families, religious spaces, and broader social structures, also reflects contemporary discussions surrounding accountability and the societal conditions that enable abuse to persist. In doing so, the play moves beyond individual experiences to interrogate the broader systems that often silence survivors.

Why Audiences Should Watch

Audiences attending *The Last Victim* should not expect a conventional evening of entertainment.

Instead, they can anticipate an experience designed to evoke empathy, provoke introspection, and encourage dialogue. For students, educators, parents, religious leaders, policymakers, and members of the public, the production presents an opportunity to engage with issues that continue to affect countless individuals, often behind closed doors.

Theatre's greatest strength lies in its ability to make audiences feel as much as they think. By witnessing the journeys of survivors on stage, viewers may find themselves reflecting on their own assumptions, experiences, and responsibilities within their communities.

Moreover, supporting productions such as *The Last Victim* contributes to sustaining a vibrant culture of socially conscious theatre in Ghana one that recognizes art not merely as entertainment, but as a catalyst for awareness, healing, and social transformation.

A Call To Witness, Reflect, And Respond

As the curtains prepare to rise at the ETS Drama Studio this August, *The Last Victim* promises to be more than a theatrical performance. It seeks to become a conversation starter; a mirror held up to society, and perhaps, for some, an affirmation that their voices matter.

In confronting silence and amplifying stories of survival, Emmanuella Dzifa Oklu's production reminds audiences of a simple yet profound truth: some stories are not meant to remain hidden.

The Last Victim will be staged from August 13–15, 2026, at 7:00 p.m. at the ETS Drama Studio, University of Ghana. For those willing to listen, reflect, and engage, this may well be one of the most important theatrical experiences on the University of Ghana stage this year.

Ghana Needs US\$37bn Annual Infrastructure Investment-World Bank



Ghana needs an estimated US\$37 billion every year to close its infrastructure gap and support sustainable urban development, the World Bank has said.

The Bank stressed that greater investment in infrastructure, stronger local institutions and effective implementation of the National Urban Policy will be essential as Ghana's urban population continues to grow.

Speaking at the ninth Ghana Urban Forum in Accra, Madhu Raghunath, Urban Resilience and Land Practice Manager at the World Bank, said Ghana has become one of the most urbanised countries in Sub-Saharan Africa.

According to her, 57 per cent of the country's population now lives in cities and towns. Moreover, the urban population is expected to more than double by 2050, increasing pressure on infrastructure and public services.

"There is a huge infrastructure gap. Ghana's Infrastructure Plan (2019) estimates a staggering US\$37

billion is needed annually to build the infrastructure that supports economic growth and improves quality of life by 2047," she said.

Urban Challenges Demand Urgent Action

Raghunath identified flooding, inadequate housing, poor waste management and severe traffic congestion as some of the country's most pressing urban challenges.

She noted that Accra alone records average annual flood-related asset losses exceeding US\$20 million, making it one of the most flood-prone cities in Sub-Saharan Africa.

Housing also remains a major concern. The number of people living in slums increased from 5.5 million in 2017 to 8.8 million in 2020, highlighting the need for affordable housing and better urban planning.

Meanwhile, poor waste management continues to threaten public health and the environment.

According to the World Bank, many urban households still lack

access to formal waste collection services. Consequently, 38 per cent dispose of waste at uncontrolled dumpsites, while 23 per cent rely on open burning, contributing to air pollution and climate change.

Integrated Investment Key to Sustainable Cities

Raghunath urged Ghana to adopt an integrated approach to urban development by investing in transport, electricity, housing and waste management simultaneously.

She also encouraged the government to strengthen public-private partnerships, expand municipal financing and build the capacity of local institutions to improve service delivery.

In addition, she said well-planned cities would reduce business costs, improve productivity and create more opportunities for young people and informal workers.

"Getting urbanisation right is central to Ghana's jobs and productivity agenda," she said, adding that efficient cities connect businesses

with workers, improve mobility and expand access to essential services. Government Launches National Urban Policy

During the forum, the Government officially launched the National Urban Policy, which aims to promote inclusive urban development, affordable housing, climate resilience, improved mobility and stronger citizen participation.

Ahmed Ibrahim, Minister for Local Government, Chieftaincy and Religious Affairs, said the policy would improve living conditions in informal settlements while preventing the emergence of new slums.

He also urged Metropolitan, Municipal and District Assemblies to integrate the policy into their development plans and budgets.

According to the Minister, successful implementation will determine whether Ghana can build resilient, inclusive and sustainable cities that support long-term economic growth.

Trotro Diaries

With Gloria E. Yanney



Every morning, thousands of commuters across Accra begin a familiar routine, rushing to work, searching for vehicles, battling traffic, and hoping to arrive at their destinations on time. For many, a trotro (public transport) is simply a means of transportation, but after several days of observing my daily commute, I realised it is much more than that. It is a moving space where different personalities, struggles, conversations, and unexpected moments come together.

My journey usually begins from Addogono in Nungua. By 8:00 a.m., I leave home and take a taxi to Ecobank Spintex, a trip that costs between GH¢4 and GH¢5 depending on the driver. From Ecobank, I join a trotro heading towards Madina, alighting at Atomic, the first junction. From there, I walk to the taxi station and take another taxi towards Action School, getting off at the T Junction where my workplace is located.

Although this route has become part of my daily routine, no two

journeys feel exactly the same. Every morning and evening brings a different experience, and each vehicle carries a collection of strangers with their own stories.

One thing that immediately stands out about Accra's trotro culture is the race against time. Traffic remains one of the biggest challenges for commuters, especially around areas such as Atomic and Flower Pot, where congestion can significantly delay journeys. A trip that should take a shorter time can stretch longer depending on the situation on

the road. For workers trying to arrive early, these delays can be frustrating, especially when every minute counts.

Despite the challenges, trotro drivers and mates have developed their own ways of navigating the city. Drivers often use alternative routes familiar to them to avoid heavy traffic and reduce delays. Meanwhile, mates stand by the roadside calling out destinations, hoping to attract passengers travelling in that direction. Their voices have become part of the soundscape of Accra's transport system.

Inside the trotro, another world exists. The atmosphere changes depending on the time of day. In the morning, gospel songs are often played, creating a motivational start to the day for both drivers and passengers. During the day, hip-hop and afrobeats usually take over, with passengers showing interest when their favourite songs come on. In the evening, many drivers tune into radio stations for news updates, and passengers often pay attention to current events while returning home after a long day.

However, not every moment inside the vehicle is peaceful. Sometimes, passengers unknowingly disturb the quiet atmosphere shared by everyone. On one occasion, a passenger sitting close to me chewed popcorn loudly with his fingers. The sound was noticeable enough to attract attention from other passengers, including myself. Although it was a simple action, it showed how small personal habits can easily affect others in a shared

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public space.

Another experience involved a woman having a loud phone conversation about detailed family issues. "He has 'chopped' the money! He said he has used the money and would re-imburse me later, such insolence! the middle-aged woman said angrily and very loudly after taking a call in a Madina-Spintex bound trotro.

It felt normal to many passengers

Beyond these everyday moments, trotro journeys also reveal the risks commuters face. On one occasion, a passenger was seen hanging behind a vehicle because he did not want to pay transport fare to his destination. A private car driver noticed and alerted the trotro driver about the danger. Although such situations may seem common on Accra's roads, they can put both passengers and drivers at risk, especially if authorities notice and take action.

That experience reminded me that commuting is not only about reaching a destination. Passengers are constantly exposed to unexpected situations, and sometimes a normal journey can quickly become an unpleasant experience.

The interactions between drivers and mates also reveal another side of trotro culture. Arguments sometimes occur when drivers fail to stop at agreed locations to pick passengers or when there are disagreements over transport

Rain also changes the dynamics of travelling. Some drivers continue operating regardless of the weather, as passengers still need to reach their destinations. However, drivers usually reduce their speed to avoid dangerous potholes and accidents caused by slippery roads or hidden traps.

After observing these daily journeys, I have come to see the trotro as more than just public transportation. It is a reflection of Accra itself; busy, unpredictable, loud, and filled with different stories. Every passenger carries



as they listened unwillingly to private matters being discussed openly. In a confined space like a trotro, personal conversations can quickly become public, reminding commuters that they are sharing more than just a seat with strangers.

Food also forms part of the commuting experience. Some passengers buy snacks such as plantain chips as early as 8:00 a.m., either because they are hungry or because they need something to keep them through the day. Roadside hawkers have become an important part of transport culture, providing commuters with quick options while vehicles wait at stations or traffic lights.

One of the most memorable experiences from my commute happened on a Monday evening while I was getting off a trotro. As I stepped down from the vehicle, a metal part inside the car cut my left toenail. I did not immediately realise how serious the injury was until a stranger pointed it out and told me to look at my toe. When I checked, I was bleeding heavily.

Other passengers quickly alerted the driver, but his reaction showed little concern about what had happened. It was the mate who came to apologise for the inconvenience caused. I later visited a nearby pharmacy, where I requested a tetanus injection as a precaution against any possible infection or serious injury.

fares. On one occasion, while trying to board a trotro from Atomic to Spintex, two mates had a disagreement over the fare being charged. One questioned why the other was charging GH¢12 instead of GH¢11 for the same route, delaying the departure of the vehicle.

Despite these challenges, there are also moments of humour. Mates are known for their confidence and sometimes use playful compliments when beautiful passengers board the vehicle, attempting to impress them or get their contacts. These small interactions add personality to the otherwise routine experience of commuting.

a personal experience, and every journey provides a brief opportunity to witness the lives of strangers.

The trotro may only be a vehicle, but within its limited space, it captures the realities of everyday life in Accra. It carries workers rushing to their jobs, students chasing their dreams, vendors making a living, and strangers unknowingly sharing moments that reveal the human side of the city.

For me, every ride has become a diary; one written not with words, but with the countless stories found on the roads of Accra.

Silicon, Not Software, Will Decide the AI Race

By Antonin Bergeaud and Robin Rivaton



Did the AI boom begin when it did simply as a result of scientific breakthroughs? At first glance, it would seem so. The transformer architecture—the foundation of today’s large language models—was introduced in 2017. By 2020, researchers had established the basic logic of scaling: more computation and data produce predictably better models. Then, in late 2022, the public launch of ChatGPT revealed the mass-market appeal of these technologies, setting off a global race for AI leadership.

Scientific advances alone, however, do not trigger investment booms. Rather, AI delivered a market-wide shock to the semiconductor and computing ecosystem. The transformer opened a promising technological path; ChatGPT created the mass market that justified large-scale investment; and systems such as Codex extended demand into applications like software development.

What followed was an unprecedented wave of investment, fueled by a combination of algorithmic innovation, hardware advances, and the emergence of a mass market for machine intelligence. For all the hype surrounding frontier

models, the future of AI depends on processors, networking equipment, cooling systems, electricity, cloud platforms, and the organizational capacity to coordinate them all.

Economists have long recognized that market size shapes the trajectory of innovation. In a seminal 2004 paper, Nobel laureate economist Daron Acemoglu and Joshua Linn showed that larger potential markets—driven by demographic change—stimulated pharmaceutical innovation.

The same logic applies to AI, albeit with an important qualification. In pharmaceuticals, the demand shock came from outside the industry as populations aged. With AI, by contrast, successive breakthroughs have created demand for even greater computing power. ChatGPT created the market that now finances the hardware on which its successors will be trained, and the prospect of a vast market for machine intelligence has made innovation far more profitable. This is true not only for semiconductors, software, networking, and data-center infrastructure, but also in sectors like energy and construction, which have long struggled to raise productivity.

Yet technologies do not improve

at the same pace indefinitely. As they mature, they face diminishing returns, making further advances progressively harder. This helps explain why technological progress often slows after an initial burst of rapid acceleration. Occasionally, however, a new technological paradigm emerges that resets the “innovation clock”—a mechanism described in recent work by Nobel laureate economist Philippe Aghion and his co-authors.

AI is such a reset, but with a distinctive twist. Rather than simply inaugurating a new technological paradigm, it has restarted the semiconductor innovation cycle by creating a new and seemingly insatiable demand for computing power.

The Limits of Moore’s Law

The AI boom is therefore best understood not as an isolated technological event but as the latest chapter in a decades-long cycle of innovation and investment. Since the invention of the transistor at Bell Labs in 1947, the tech industry has been transformed by successive waves of change: mainframes, personal computers, the internet, mobile devices, cloud computing, and now AI.

These waves are often portrayed as the inevitable consequence of Moore’s law—the observation that the number of transistors on an integrated circuit doubles every two years. But this interpretation overlooks a powerful feedback loop: Moore’s law operated as a virtuous cycle in which technological progress and market expansion reinforced one another. Cheaper compute enabled new applications, expanding the market for computing and making continued investment in chips, manufacturing tools, memory, software, and digital infrastructure profitable.

Unlike earlier computing waves, AI places enormous strain on physical infrastructure, from parallel processing and memory bandwidth to high-speed interconnects and data-center capacity. Compounding the problem, its emergence came after the breakdown of the energy bargain that sustained Moore’s law.

For decades, Moore’s law was complemented by the Dennard scaling principle: as transistors became smaller, they could operate at lower voltage. This kept thermal loads under control, allowing each new generation of chips to deliver more computing power without requiring commensurate investments in electricity, cooling, and physical infrastructure.

That bargain began to unravel in the mid-2000s. Although transistors continued to shrink, voltage could no longer drop as quickly, preventing processors from running faster without overheating. To sustain progress, innovation expanded beyond the transistor itself to encompass the entire computing stack: multicore processors, graphics processing units, specialized accelerators, high-bandwidth memory (HBM), advanced chip packaging, hyperscale cloud infrastructure, and high-speed networking.

Generative AI is the first mass-market application to make full use of this post-Dennard architecture. A chatbot may appear weightless to users, but behind its interface lies an enormous physical apparatus. Training frontier models requires vast amounts of parallel computing,

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high-speed data transfer, dense clusters of specialized chips, industrial-scale cooling, and abundant, reliable electricity.

The AI rupture, then, is not merely about software; it is also about physical capital, energy, and industrial capacity. According to Stanford's 2025 AI Index, the amount of computing power used to train advanced AI models has been doubling roughly every five months. Epoch AI estimates that computing power devoted to

today's dominant AI firms are those that coordinate the complementary investments required to turn scientific advances into economic value. Nvidia's competitive advantage, for example, rests on the decades-long development of CUDA—the platform through which developers use its chips—together with its software libraries, technical expertise, advanced packaging, and supply-chain coordination.

TSMC's dominant position likewise reflects the value of its manufacturing expertise. Amazon, Microsoft, and Google, by contrast, convert dispersed

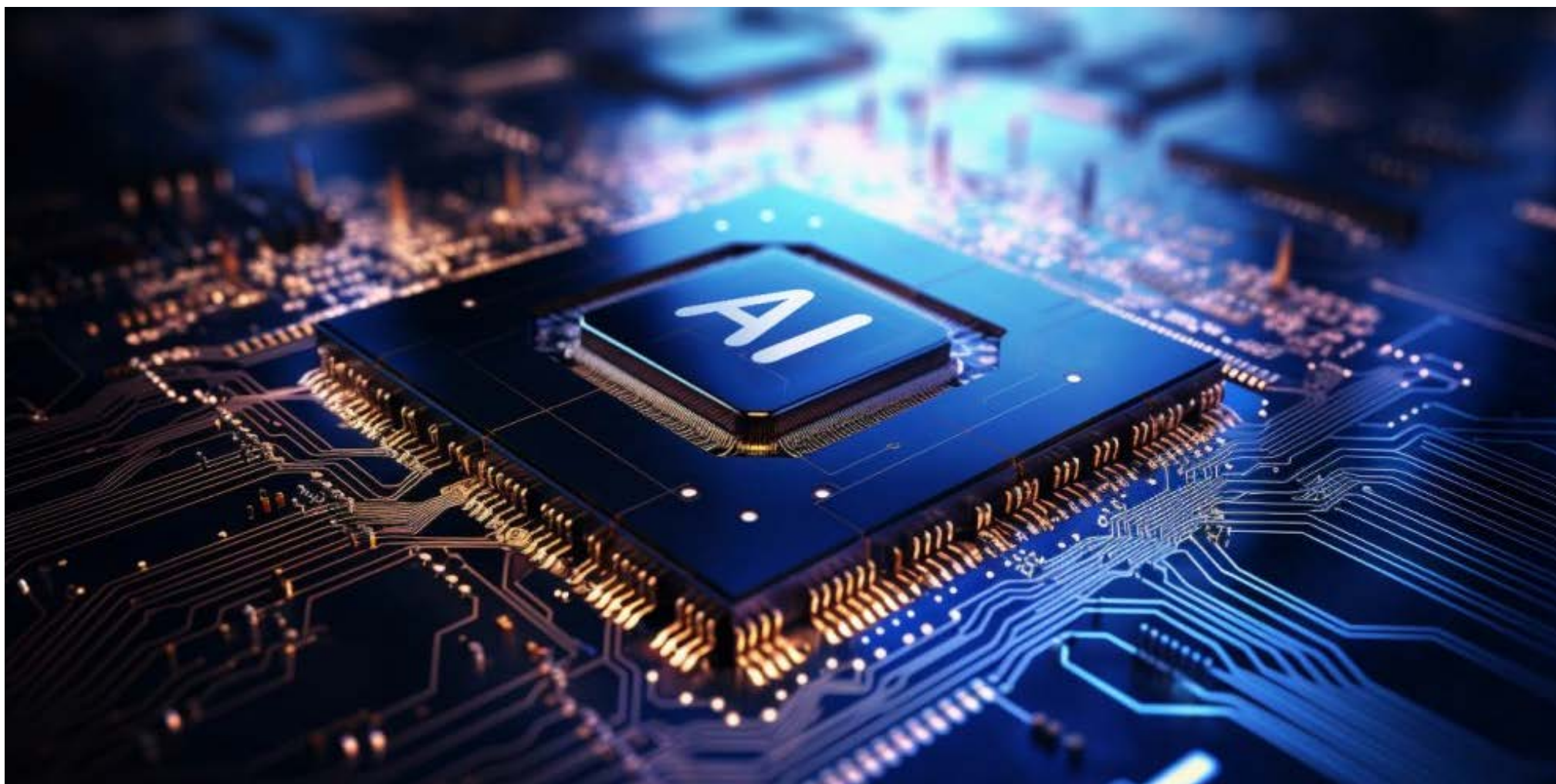
concentrated in Taiwan.

But rising geopolitical tensions have led policymakers to rediscover the strategic importance of manufacturing capacity. The 2022 US CHIPS and Science Act marked a sharp break with decades of fables complacency, committing roughly \$52 billion in public funding and catalyzing more than \$450 billion in announced private investment in domestic semiconductor production.

The effects are already visible. TSMC has recently increased its planned investment in its Arizona megaproject

With that in mind, South Korea launched an industrial-policy push that, in 1983, made it the third country in the world, after the US and Japan, to produce 64K DRAM chips. Samsung and SK Hynix built on that early lead to form, together with the US-based Micron, an oligopoly that controls more than 90% of the global DRAM market. SK Hynix has also emerged as the leading supplier of HBM, a critical input for training frontier AI models.

China offers the most striking demonstration of what ambitious industrial policy can achieve. Over



training frontier models has increased nearly fivefold each year since 2020.

But compute is only one of AI's essential inputs. The other is the immense body of digital information created by earlier computing waves. The internet transformed decades of human text, code, images, audio, and video into a vast digital archive, while the collapse in storage costs—another consequence of relentless advances in semiconductor manufacturing—made it economical to preserve virtually all of it. Pre-training is, in effect, the process of compressing all that data into a statistical model.

The result is a self-reinforcing dynamic reminiscent of the old Moore's law feedback loop: better models increase the value of additional computing power; higher expected returns justify greater investment in accelerators, memory, cloud capacity, and electricity; and those investments expand frontier AI models' capabilities by easing the bottlenecks that constrain them, enabling new applications that further boost demand for compute.

Against this backdrop, it is clear why

demand for compute into vast cloud platforms and infrastructure. Their competitive advantage rests not on any single technology, but on their ability to coordinate capital, hardware, software, and electricity at an extraordinary scale.

Industrial Policy for the AI Age

The clearest sign that silicon remains at the heart of today's technological revolution is that every major power now treats control of the semiconductor supply chain as a strategic asset. AI may look like a software revolution, but its constraints remain physical: processors, memory, manufacturing equipment, packaging capacity, and electricity. That has transformed chipmaking from a private industry into a geopolitical battleground.

The United States is a case in point. For several decades, dispensing with fabs allowed US companies to specialize in chip design while outsourcing manufacturing to overseas producers. This division of labor helped the US retain its technological lead even as advanced production became

to \$265 billion, with Apple reserving more than half of the company's initial two-nanometer (2nm) production capacity. Intel's Fab 52 plant in Arizona is already producing 18A chips, which Microsoft reportedly plans to use for its next-generation Maia accelerator.

Meanwhile, Taiwan's decades-long gamble on TSMC continues to yield extraordinary dividends. The company is effectively running its 3nm production lines at full capacity, with demand for its advanced-node chips reportedly exceeding supply by roughly three to one. Taiwan's unrivaled manufacturing capabilities have made its so-called silicon shield a strategic reality: the island's security is now a matter of vital strategic interest to the US and its allies.

South Korea's experience highlights another AI chokepoint: memory. South Korean policymakers understood long ago what their European counterparts still struggle to recognize: memory remains a strategic asset even when it appears readily available on global markets.

the past few decades, it has climbed the semiconductor value chain from the bottom up, beginning with outsourced semiconductor assembly and test (OSAT), which comprises the final stages of chip production after fabrication. Western firms largely dismissed this segment as a low-margin business, but China treated it as a strategic entry point.

That bet has paid off. Companies like JCET, Tongfu, and Huatian have expanded from contract packaging into chiplet integration and 2.5D packaging, which allows processors and memory to communicate at much higher speeds. JCET is now the world's third-largest OSAT firm, with annual revenues of \$5 billion.

From packaging, China moved into memory. CXMT's DDR5 chips—the latest generation of DRAM—reportedly reach 8,000 mega-transfers per second, enabling Chinese producers to challenge the Samsung-SK Hynix-Micron oligopoly.

The next step was fabrication.

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SMIC, China's leading foundry, is now producing Huawei's Ascend AI accelerators using deep-ultraviolet multi-patterning, a technique that extends the capabilities of older lithography systems through a series of additional manufacturing steps.

By late 2025, China had reportedly reached the industry's final frontier: lithography. After much trial and error, a Chinese consortium developed a prototype of an extreme-ultraviolet (EUV) machine—the most advanced chipmaking technology and the hardest to replicate. Officials hope to bring the technology into production by 2028, although some people close to the project consider 2030 more realistic.

crumbles, the fabless model is giving way to a new form of vertical integration. From Google's TPU and AWS's Trainium to Microsoft's Maia, the hyperscalers that dominate cloud computing are now designing their own AI accelerators.

But these companies continue to rely on TSMC to fabricate their leading custom accelerators. Vertical reintegration, it turns out, stops at the foundry door. With the strategic bottleneck shifting from chip design to manufacturing and advanced packaging, governments around the world are spending tens of billions of dollars to expand domestic chip manufacturing.

The implications extend far beyond semiconductors. The International Energy Agency projects that data-

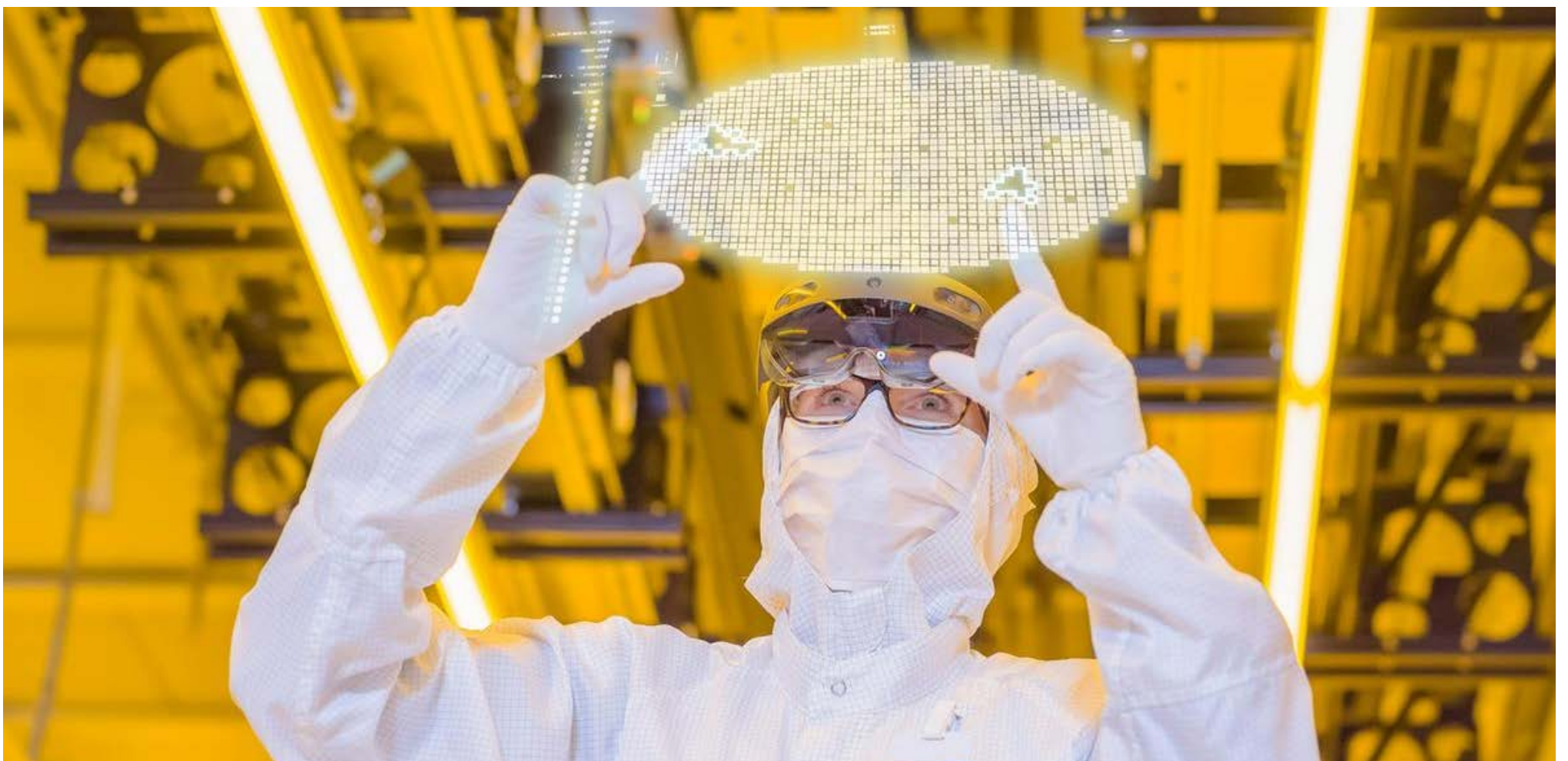
advantages, by contrast, lie in its ability to achieve self-sufficiency across the semiconductor value chain, from packaging to lithography. Europe, for its part, has struggled to turn scientific excellence into industrial leadership, treating innovation as a research problem and deployment as an afterthought.

In industries where innovation depends on scale, physical capacity matters as much as scientific ingenuity. AI is no exception, as competition shifts from developing better models to inference—that is, running them efficiently once they have been trained. While training remains essential, meeting growing demand at low cost may be the greater challenge.

The cost of running an AI model ultimately comes down to its physical

Taiwanese bets on semiconductors a generation ago. But sustaining an AI economy requires both institutional reform and a profound physical transformation.

On the institutional front, China is building a more integrated national electricity market. Every province is required to operate a wholesale electricity market, while the share of electricity traded across provincial borders has risen from 18% in 2017 to roughly 24% in 2024. The physical challenge is even greater: per capita electricity demand reached 7.5 megawatt-hours in 2025—almost double the global average and up from barely one MWh in 2000. A vast build-out of generation and transmission infrastructure will be required.



The numbers speak for themselves: China now produces roughly 35% of its semiconductor equipment domestically, with local firms supplying over 40% of the tools used in key manufacturing processes such as etching and thin-film deposition. Although the country still lags in lithography, design software, and photoresists, it has built domestic capabilities across nearly every stage of the semiconductor value chain.

These investments would make little sense if semiconductors were a mature industry on the verge of being displaced. Instead, the rise of AI has made semiconductors a central battleground in the contest for technological and military supremacy.

The Next AI Bottleneck

As the wall of separation between chip designers and chipmakers that defined the 1990s and 2000s

center electricity consumption will more than double by 2030, to roughly 945 terawatt-hours—just under 3% of global electricity use. Contrary to popular belief, the main challenge is not building more data centers but securing the land, equipment, grid capacity, and permits required to operate them.

The lesson for policymakers is straightforward. Frontier models matter, but they are only one layer of the AI stack. Technological leadership also requires computing power, electricity, cloud infrastructure, advanced semiconductors, skilled engineers, and markets large enough to justify sustained investment.

These capabilities are unevenly distributed across the world's major economies. The US combines a vast continental market, deep capital markets, world-leading cloud providers, and firms willing to deploy new technologies at scale. China's

inputs: semiconductors, electricity, cooling, and the capital invested in data centers. Today, industry estimates put servers at around 60% of the annualized cost of operating a large data center, while energy accounts for 7%. But as hardware becomes cheaper and more standardized, electricity will account for a growing share of the cost, making access to abundant, reliable power the factor that separates winners from losers.

The chip race is therefore also an energy race. After all, a less efficient processor is not a decisive disadvantage if electricity is abundant and cheap. That, in turn, reshapes the geography of AI: because data centers can be built almost anywhere, reliable, low-cost electricity matters more than proximity to cities.

In this regard, China's decade-long push to expand and modernize its electricity system could prove as consequential as the South Korean and

Whether China succeeds or not, the nature of technological competition has fundamentally changed. For decades, it was viewed as a race to push the frontiers of science and semiconductor design. Today, it is a race to build the physical infrastructure that makes scientific breakthroughs commercially viable. Now that the silicon clock has been reset, the next innovation cycle will be measured as much in watts as in nanometers.

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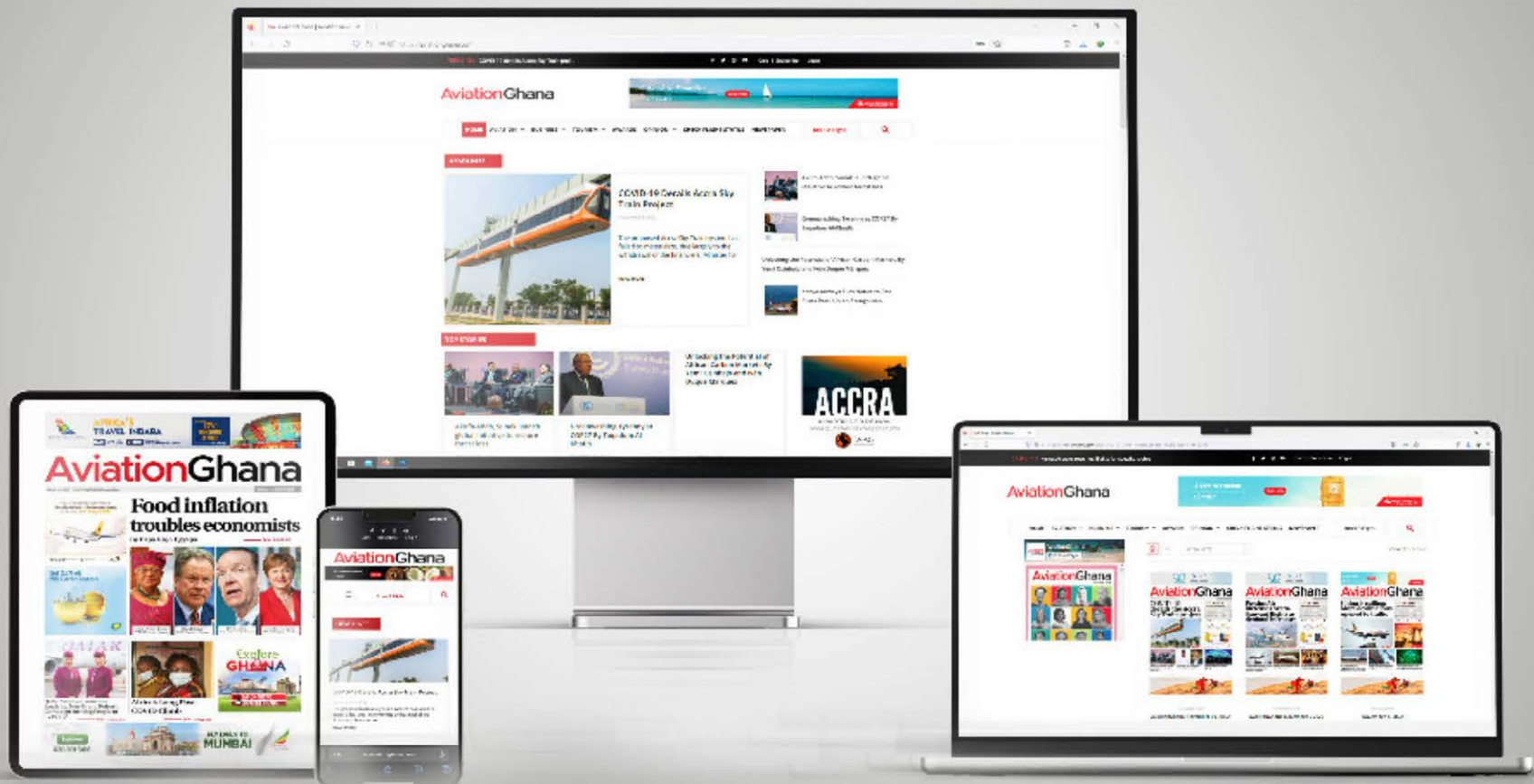
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