

Supply Chain
Sustainability Using
Artificial Intelligence
BY CHARLES H.W.
EDWARDS

Generative AI and the
Sustainable Supply
Chain: From Vision
to Reality
BY KIM WINTER

Can Generative AI Close
Supply Chain's Carbon
Gap—or Widen It?
BY MARTIN HUBERT

Multi-Hazard Early
Warning Systems
Bridge into Supply
Chain Strategy
BY WOLFGANG
LEHMACHER AND
MIKAEL LIND



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SEPTEMBER 2025

The background illustration depicts a futuristic, sustainable supply chain. In the foreground, two semi-trucks are driving on a road that appears to be part of a port or industrial zone. The truck on the left is a dark-colored cab, while the one on the right is a white cab. Both are carrying flatbed trailers loaded with colorful shipping containers. In the background, a large cargo ship is docked at a pier with several gantry cranes. The scene is set at night, with city lights and a glowing digital network overlaying the landscape. The overall color palette is dominated by blues, greys, and the vibrant colors of the shipping containers. Light trails from the trucks and the digital network create a sense of motion and connectivity.

Sustainable Supply Chains

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Generative AI and the Sustainable Supply Chain: From Vision to Reality

See article on page 11

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4 From the Editor

Features

- 5 Supply Chain Sustainability
Using Artificial Intelligence
BY CHARLES EDWARDS

- 11 Generative AI and the
Sustainable Supply Chain:
From Vision to Reality
BY KIM WINTER

- 20 Multi-Hazard Early Warning
Systems Bridge into Supply
Chain Strategy
BY WOLFGANG LEHMACHER &
MIKAEL LIND

- 27 Can Generative AI Close Supply
Chain's Carbon Gap—
or Widen It?
BY MARTIN HUBERT

News

- 32 Narrow-body aircraft lead-
ing the way toward greater
energy efficiency in the air
cargo industry
BY MAGMA

- 36 Kardex's new AutoStore
StarterGrid meets the need
for fast, scalable,
affordable warehouse
automation.
BY KARDEX

A large cargo ship with yellow cranes and a white cargo plane flying overhead.

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FROM THE EDITOR

Natasia Jerah

I started my career as a scientist, and I can still remember sitting in lecture halls, completely mind-blown by the discoveries unfolding in front of me – the strange, almost unimaginable things that something as small as a CRISPR molecule could do. Reading through this month’s contributions, I found myself feeling that same sense of awe again – this time (not surprisingly), about AI.

There’s so much hope and excitement surrounding its potential. But what struck me most from the articles wasn’t just the technology itself, but the reminder that humans still need to be at the centre of it. Human-in-the-loop decision-making matters. The system is only as good as the data we feed it. And yes, sometimes, it surprises even its creators. Vigilance is required. Complacency isn’t an option.

Another takeaway: upskilling isn’t optional either. If we’re to really harness AI, we’ll need to sharpen how we interpret signals, learn how to “talk” to these tools in ways that get the best output, and replace old spreadsheets with more sophisticated models. Learn how to educate not just our teams but customers and vendors alike on how a shift to AI benefits everyone. The list is endless, really.

What I found ironic, reading across the perspectives, is how many companies seem to be over-indexing on AI as if it’s here to replace humans. My gut tells me – and the wisdom in these pages affirms – that the real winners will be the ones who give HR an equally important seat at the table.

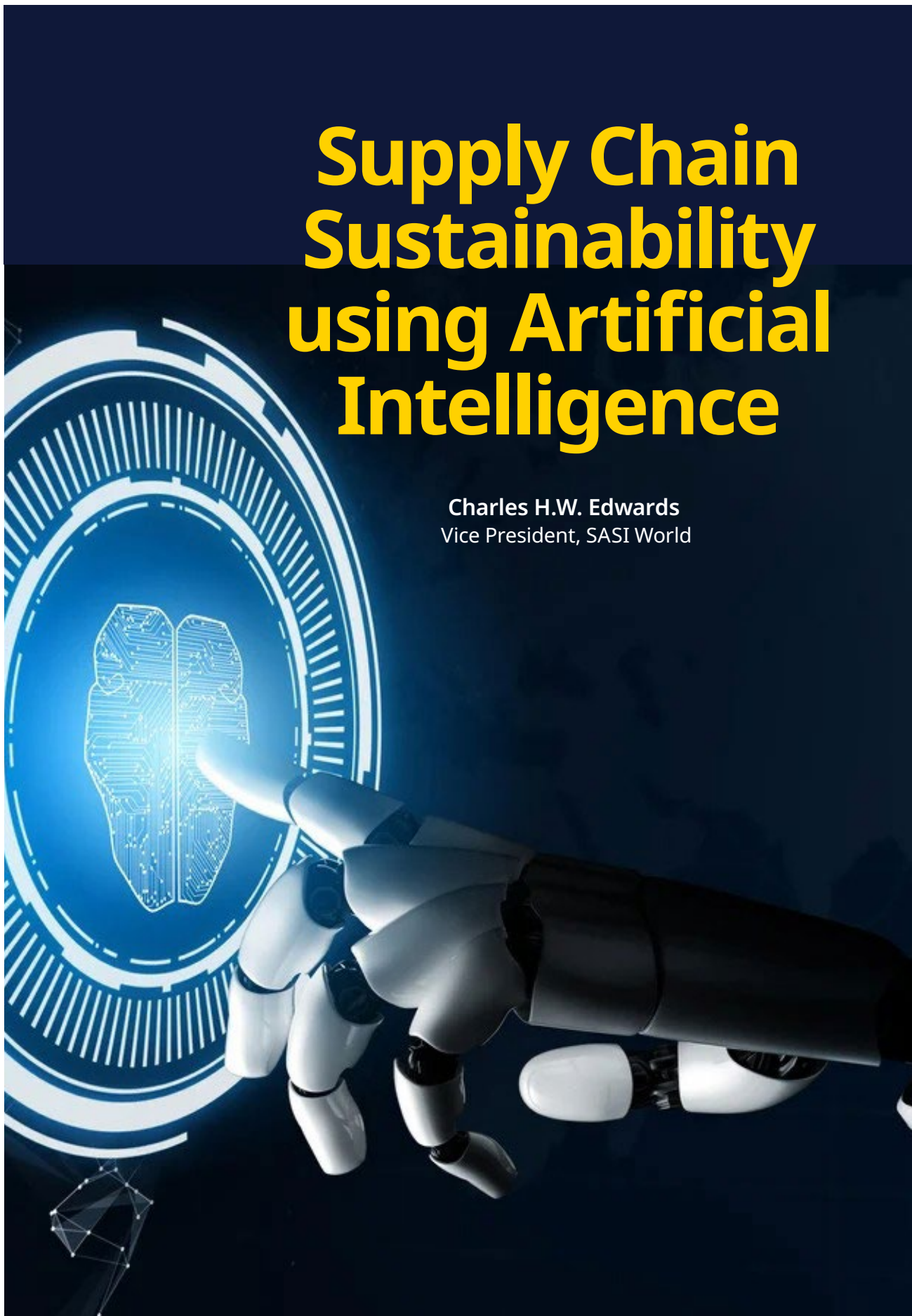
Natasia Jerah

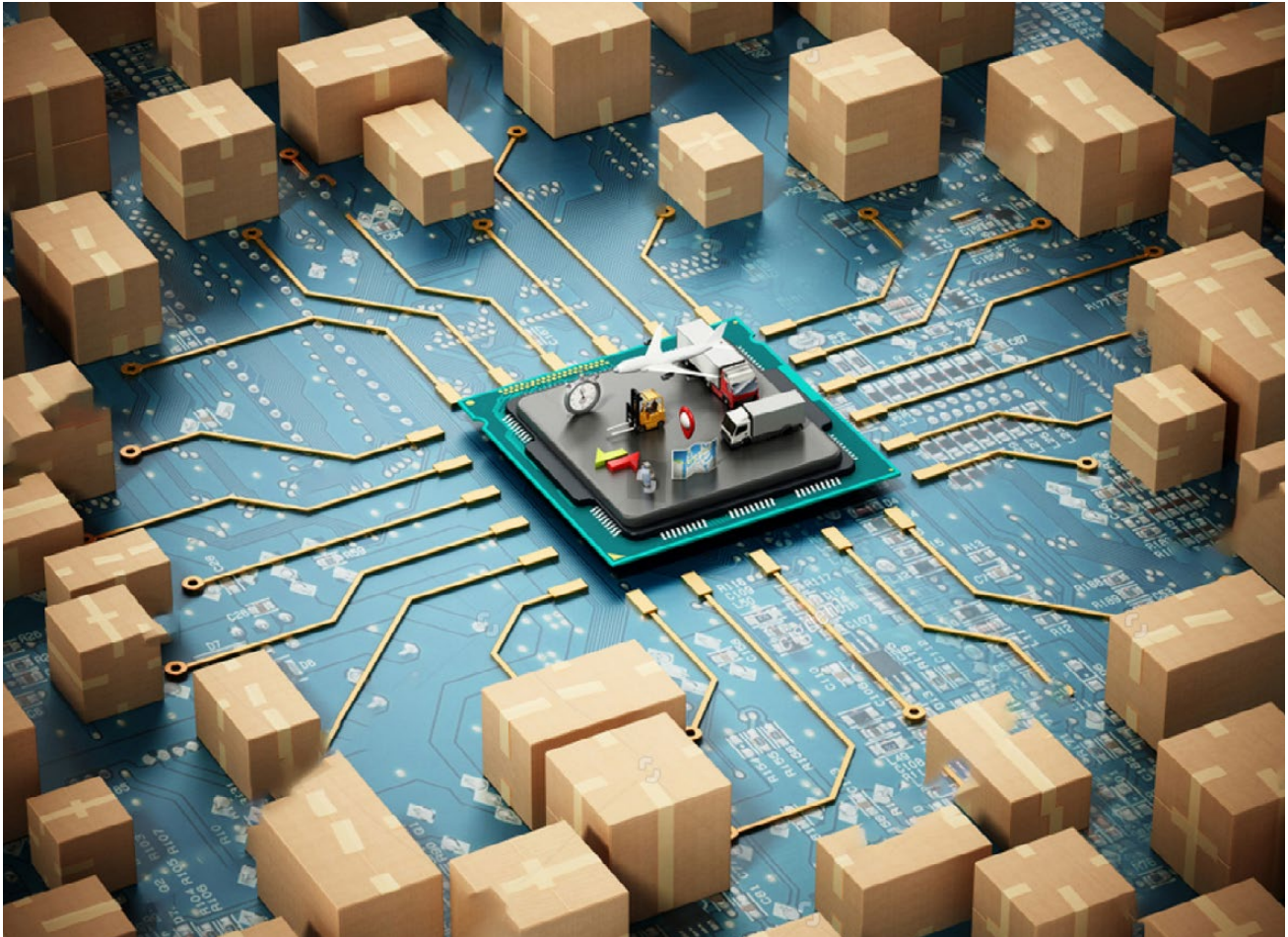
Editor-In-Chief

CargoNOW

Supply Chain Sustainability using Artificial Intelligence

Charles H.W. Edwards
Vice President, SASI World





Sustainability is defined as “meeting the needs of the present without compromising the ability of future generations to meet their own needs.” There are three core dimensions of sustainability. They include:

- **Economic** - Supporting long-term economic growth without negatively impacting social or environmental aspects,
- **Environmental** - Preserving natural resources, reducing pollution, and protecting ecosystems, and
- **Social** – Ensuring equity, human rights, and access to basic needs like education, healthcare, and community development.

Supply chains are being challenged to deliver consistent, fully transparent, high-quality and compliant services under price pressures, while simultaneously addressing external and internal issues related to long-term sustainability.

Responding to and anticipating the numerous disruptions which challenge supply chain operations and structure requires an innovative approach that employs new tools for managers and teams. This paper focuses on economic sustainability and the use of appropriate digital systems, including AI, by the worldwide air cargo logistics industry.

The challenge of embracing any new approach can be summarised by three hurdles.

- **Bias issues** – Change is always tough. Overcoming the bias against change and perceived threats to individual roles and employment or to the impact on customers’ requirements.
- **Integration challenges** – Integrating changes into legacy systems requires thoughtful education of team members, customers and vendors. The focus must be on the collaborative benefits for all.
- **Scalability and Regulatory Concerns** – Any change must be vetted to ensure that the new systems and processes

are compliant with legal and regulatory requirements. The changes must be readily scalable without undue additional cost.

Developing a vision and strategy that addresses these hurdles is the first step. The next step is to confront additional concerns, which include:

• **Data Quality and Availability** –

Every member of the worldwide air cargo logistics industry possesses a wealth

of information and data. The challenge is multifold when making changes that will alter internal processes as well as external connections. Is the information accurate? How can it be protected? How can it be used for short-term applications and long-term strategies? These and many other questions must be addressed in a thoughtful, respectful, and detailed process.

• **Identifying Appropriate Technologies** – The rush to adopt and apply new

technologies can create numerous problems. Identifying the appropriate technologies must be grounded on the individual company's goals as well as its relationships with customers and vendors.

Purchasing a new I.T. system that is not modified to the unique needs and processes of the company can, and has in the past, put the buyer in financial peril.

Recognising and formalising strategies to respond to

Application	General Application for A.I.	Air Cargo + Logistics Application
Optimized Routing & Logistics	Intelligent route planning to minimize fuel consumption and emissions.	Dynamic routing of trucks, ships, containers to reduce dwell time.
Demand & Supply Forecasting	Analyze vast data sets to predict demand more accurately, reduce overproduction and waste.	Analyze consignment data sets, traffic forecasts, and capacities to predict demand-supply imbalances.
Supplier Selection and Monitoring	Evaluate suppliers based on environmental and social governance (ESG) metrics, help companies choose and monitor sustainable partners.	Evaluate and select logistics partners based on compliance with environmental regulations and innovative emission reduction programs.
Resource & Energy Management	Identify inefficiencies in production and warehousing inefficiencies, suggest ways to reduce energy use or switch to renewables.	Match staffing to consignment flows including special handling, and ULD build-up and breakdown.
Customer Sentiment Analysis	Align company products and practices with eco-conscious consumer values.	Analyze customer satisfaction surveys, adoption of new products and pricing programs.
Circular Economy Support	Design products for reuse and recycling and improve reverse logistics.	Design protocols, services to handle return consignments.
Carbon Tracking & ESG Reporting	Track carbon emissions across the supply chain and generate actionable sustainability score-cards.	Implement systems to reduce dwell times at cargo terminals

the concerns listed above will significantly increase the probability of success. Identifying and addressing all the likely problems upfront is key to creating a project management plan that will be completed on time and on budget. This homework lays the foundation to develop a vision and strategy to implement changes to structures, systems and processes.

There are seven primary applications of Artificial Intelligence (A.I.) in supply chain operations and management. The following summarises each use and its application. The applications

for the worldwide air cargo logistics industry reflect the current uses of AI in other industries.

Airport cargo community systems (ACCS) linked to AI tools are the suggested way forward for all members of the worldwide air cargo logistics industry to adopt and use digital tools and ensure long-term sustainability in an era of constant and varied disruptions. The power of these platforms is magnified exponentially when ACCS platforms are linked via Digital Logistics Corridors [v]. In conclusion, all members of the worldwide air cargo logistics industry must

collaborate. The strengths of small and mid-sized companies are the bedrock of the industry. At the same time, a race to adopt new technologies, including artificial intelligence, must be measured and address all internal and external concerns. Just as the tortoise beats the hare over a long distance, it is not the speed at the start that wins the race. Rather, it is the preparation and the attention to detail in the vision and strategy that are needed to adopt AI and reap the associated benefits.



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In 2010, he co-authored *Transport Logistics: The Wheel of Commerce* and a contributing author of the MHI sponsored *Material Handling & Logistics Roadmap 2.0* (2017). Mr. Edwards has hosted the UNC-Chapel Hill - Tsinghua University Logistics EMBA program in Dubai and is co-developer of the Air Cargo Professional Development workshop program of The International Air Cargo Association. He also serves on various international and US logistics industry boards.

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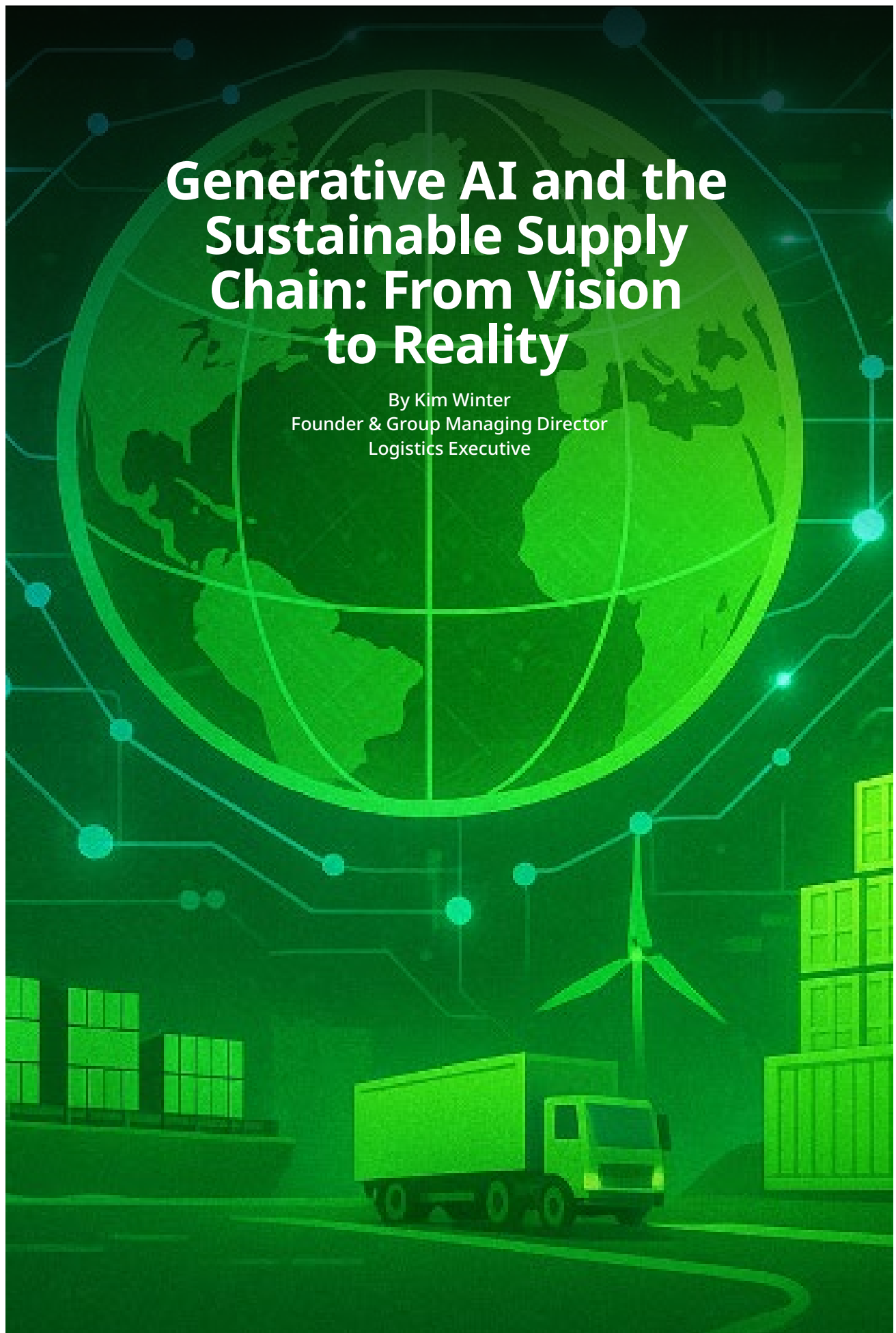

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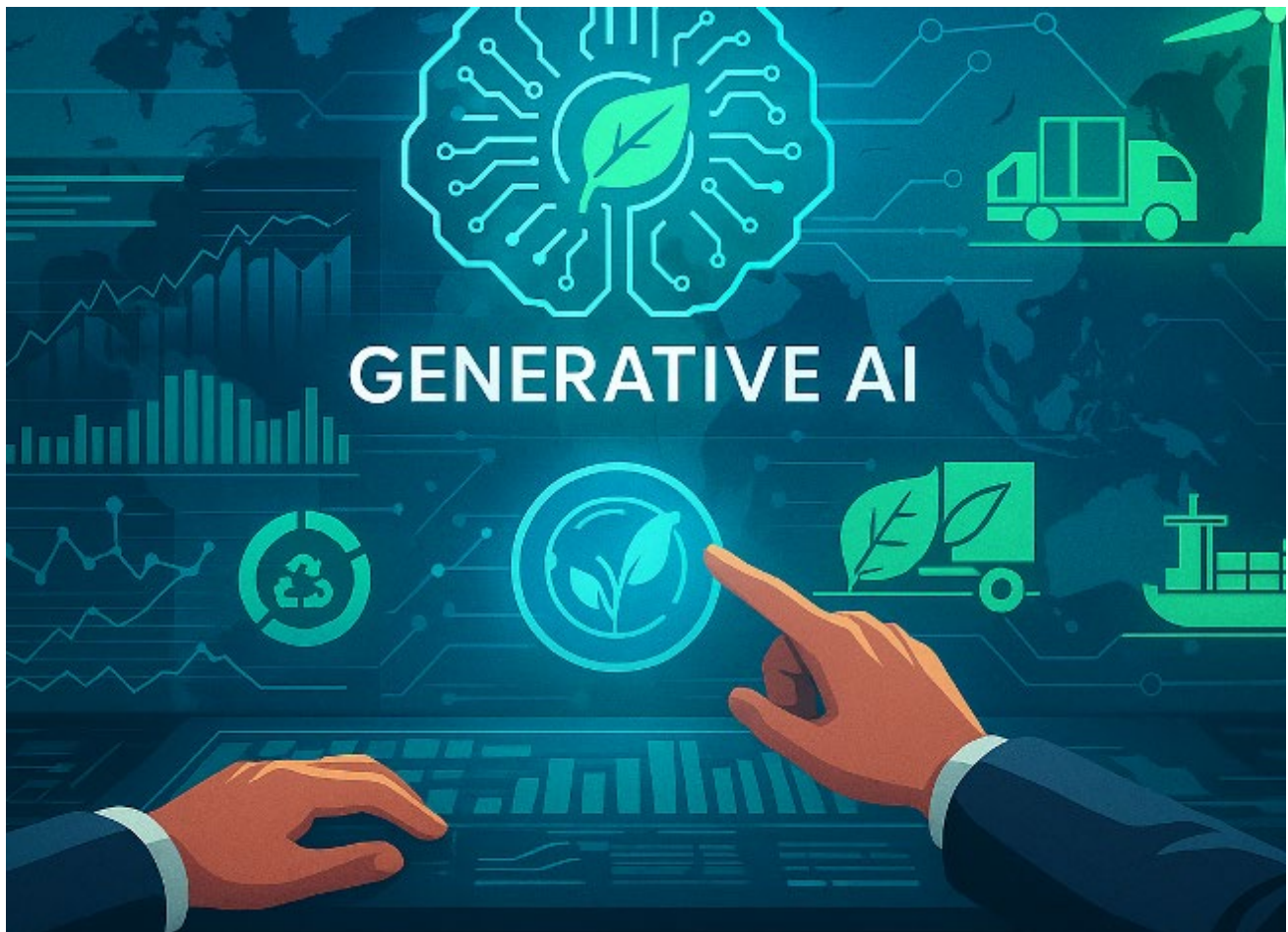
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Generative AI and the Sustainable Supply Chain: From Vision to Reality

By Kim Winter
Founder & Group Managing Director
Logistics Executive





Lead

Global supply networks have been shaken by pandemic disruptions, the climate crisis, geopolitical realignments and shifting consumer expectations. After several years spent building resilience and visibility, supply chain leaders now face a new imperative: sustainability. Legislators in Europe and North America are requiring companies to report emissions across their value chains, investors are pressuring firms to cut waste and carbon, and customers are rewarding businesses that demonstrate ethical sourcing and circularity. The shift demands granular knowledge of costs and environmental impacts across every node of a network. At the same time,

a fresh wave of digital technologies promises to transform planning, sourcing, making and moving goods. Among these technologies, generative artificial intelligence (GenAI) has seized attention for its ability to synthesize vast datasets, generate new content and recommendations, and learn from feedback. Early use cases suggest that GenAI could streamline procurement, route planning and supplier management. Yet deploying a technology that relies on enormous computing resources also raises concerns about energy and water use. This article examines how Gen AI is being applied to build sustainable supply chains, the benefits demonstrated in current pilots and the

challenges companies must address to ensure that AI's environmental footprint does not outweigh its gains.

The supply-chain sustainability imperative

Supply chains are responsible for the majority of many companies' greenhouse gas emissions and natural resource use. Recent regulations such as the European Union's Corporate Sustainability Reporting Directive (CSRD) and the U.S. Securities and Exchange Commission's proposed climate disclosure rules require firms to account for Scope 3 emissions, the carbon generated in upstream procurement and downstream distribution.

According to KPMG, supply chain leaders in 2025 must deliver genuine value by deeply understanding the cost implications of different products, customers and channels, and by evaluating the environmental and social practices of their suppliers. New laws and stakeholder demands are making sustainability a strategic differentiator rather than an afterthought. To meet this challenge, organisations need data driven insights into the carbon intensity of logistics, production and materials, along with tools to design greener networks and measure progress in real time.

What is generative AI and why does it matter?

Artificial intelligence has been used for years to predict demand, optimise inventory and manage procurement. Generative AI refers to a subset of AI that does more than classify or predict: it generates new content or scenarios based on the patterns it learnt. Large language

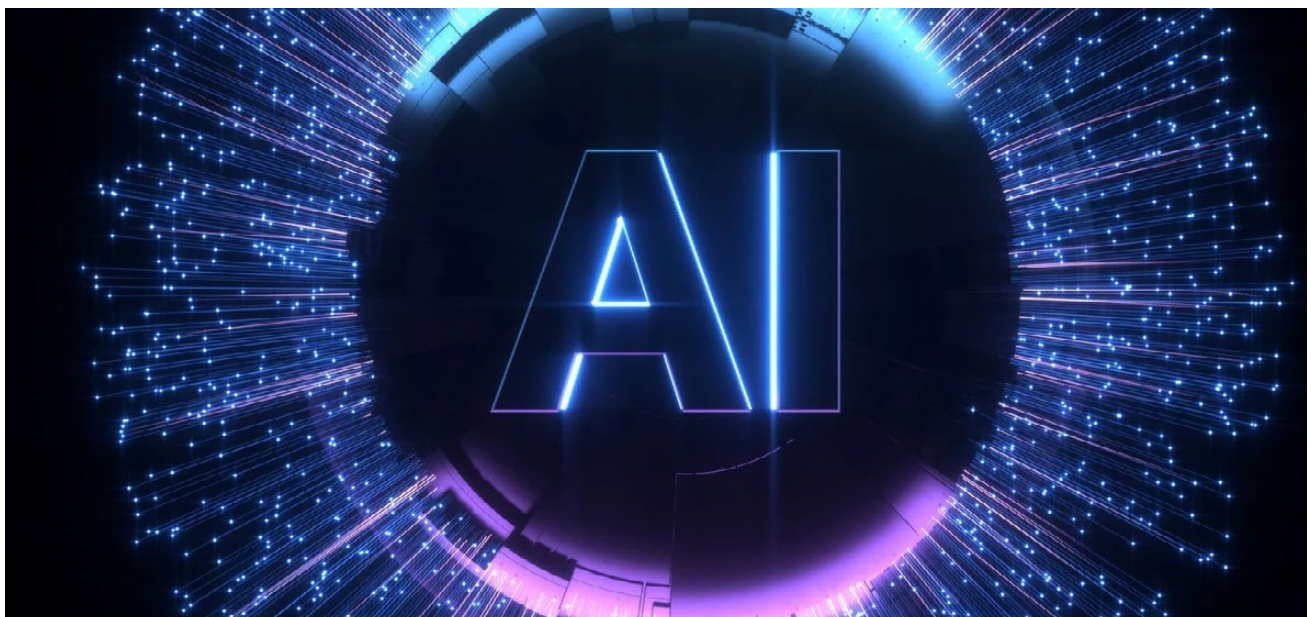
models (LLMs) like ChatGPT can produce human like text; diffusion models create synthetic images; and increasingly, domain specific models output code, designs or forecasts. GenAI can ingest structured and unstructured data, sales histories, weather forecasts, supplier audits and ESG reports and generate summaries, risk scenarios or recommended actions. According to EY, around 62% of supply chain organisations already use AI for sustainability tracking and measurement, and 40% are investing in generative AI. With improved user interfaces and the ability to chat in natural language, GenAI tools make advanced analytics more accessible across planning, sourcing, manufacturing and logistics.

How generative AI is transforming sustainable supply chains

Route and freight optimisation

Inefficiencies in transportation from half empty trucks to congested ports add up to higher emissions and costs. An article by logistics platform GoComet describes how generative AI analyses real time conditions and dynamically reroutes shipments, preventing waste before it occurs. Rather than following fixed schedules, AI driven systems generate “smart, adaptive paths” that adjust to traffic, fuel prices and weather. Businesses that have implemented AI driven route optimisation report up to a 10% reduction in fuel consumption, leading to lower transportation costs and fewer emissions. Ocean freight scheduling algorithms ensure that ships arrive when ports are less congested, avoiding idle time that burns unnecessary fuel.

GenAI also tackles one of logistics’ biggest inefficiencies: empty miles. By analysing shipment patterns and running multiple load consolidation scenarios, the technology identifies opportunities





to combine compatible shipments and maximise space utilisation. Fewer trips mean lower fuel use and reduced strain on supply chains. In addition, predictive tools simulate disruptions (from weather or geopolitical crises) and suggest proactive adjustments. During the Red Sea crisis of 2023–24, a global textile manufacturer used GoComet’s predictive estimated time of arrival (ETA) to align production with delayed shipments, preventing downtime and expensive last minute air freight.

Demand forecasting and inventory optimisation

Accurate demand forecasting is essential for minimising waste. Traditional models often miss complex patterns, leading to overproduction or stockouts. Generative AI models can consider historical sales, market trends and external factors simultaneously. They

“model various situations and generate analyses” so businesses can explore diverse scenarios and adjust production accordingly. Microsoft’s Dynamics 365 Copilot uses the Azure OpenAI Service to predict disruptions across suppliers and geography, identify external risks and recommend actions. Early adopters achieved a 90% return on investment within three years and improved operational efficiency by US\$1.5 million. Domino’s Pizza UK & Ireland automated demand prediction using AI and analytics, improving its forecasting accuracy and moving away from error prone spreadsheets. GenAI also optimises inventory levels and warehouse operations. By forecasting ideal stock based on demand trends and external factors, AI helps businesses avoid overstocking while preventing shortages. In warehouses, the technology

can optimise layouts and automate energy use, making operations greener and more cost effective.

Supplier selection and vendor negotiation

Selecting suppliers solely on cost no longer suffices. GenAI tools evaluate partners based on carbon footprint, labor practices and energy efficiency. GoComet notes that AI dives into data-driven insights to help companies choose suppliers who align with environmental goals without sacrificing reliability or cost[19]. Deloitte’s Tore Christian Jensen argues that GenAI provides real-time insights into ethical practices of suppliers, allowing businesses to track the origins of raw materials and ensure responsible procurement. This capability helps companies meet CSRD requirements and build trust with stakeholders.

Generative AI is even

entering negotiations. EY reports that a leading US retailer and a European container shipping company use GenAI-powered bots to negotiate purchasing terms with suppliers, reducing costs and structuring complex tender processes. When surveyed, over 65 % of vendors preferred negotiating with the AI bot rather than with company employees. Natural-language processing can extract key information from large contracts, highlight risks and suggest renewal strategies.

Manufacturing and predictive maintenance

In the manufacturing sector, GenAI accelerates product design by rapidly generating and evaluating hundreds of alternative configurations based on predefined criteria. Engineers can use AI generated designs to improve the efficiency, durability or sustainability of parts. Predictive maintenance models learn from machine data to create maintenance schedules that align with likely failure times, reducing downtime and extending equipment life. EY notes that a leading industrial manufacturing company partnered with a technology vendor to use GenAI for factory automation, shortening product development cycles and boosting efficiency. Master of Code's analysis describes predictive maintenance as a major opportunity, enabling manufacturers to anticipate equipment failures and reduce costs.

Logistics and last-mile delivery

AI enhanced logistics extend beyond route optimisation. In warehouses, GenAI platforms can optimise picking routes, boosting workforce productivity by about 30% and reducing operational costs. For global trade, the technology analyses variables such as tariffs, customs regulations and shipping costs to recommend the most efficient and compliant routes. GenAI can design logistics networks by choosing optimal warehouse locations and transport links and continuously update last mile delivery routes based on traffic, weather or delivery priorities.

Transparency and ESG reporting

A growing body of regulation requires companies to demonstrate that their supply chains meet environmental and social standards. Deloitte explains that GenAI "equips companies to meet these new standards by providing real time insights into the ethical practices of suppliers" and enabling them to track origins of raw materials with verifiable data. Companies can evaluate suppliers' sustainability practices, ensure responsible procurement and align with ESG goals. GenAI thus transforms sustainability from a long term aspiration into an operational reality.

Business benefits and early results

Early adopters report tangible benefits from AI enabled supply chains. GoComet notes that companies adopting AI powered sustainable logistics reduced logistics expenses by 15%, lowered stock levels by 35% and improved service efficiency by 65% compared with businesses using traditional methods. These gains illustrate how sustainability and efficiency can be mutually reinforcing. Other benefits include:

- Cost savings – AI driven route optimisation cuts fuel consumption, smarter inventory forecasting reduces warehousing expenses, and automated energy management lowers operational costs.
- Regulatory compliance – AI tracking of real time emissions, route optimisation and automated reporting simplifies adherence to carbon emission standards.
- Brand value and customer demand – Strong sustainability initiatives attract investors, business partners and talent. Consumers increasingly prefer eco conscious brands, and AI powered transparency builds trust.
- Risk mitigation – GenAI can simulate disruptions and propose contingency plans, helping companies avoid expensive surprises. EY highlights that AI generated risk assessments and scenario simulations help planners manage risks proactively.

Challenges and environmental concerns

Computational footprint

The excitement surrounding GenAI often overlooks its environmental cost. Yale Environment 360 reports that the rapid deployment of generative AI requires massive amounts of energy for computation and data storage and millions of gallons of water to cool the equipment at data centres. A session of roughly 10–50 interactions with GPT 3 may consume around half a litre of fresh water due to cooling requirements. Globally, data centres consumed an estimated 1,000 terawatt hours of electricity in 2026, about twice their consumption in 2022 and roughly equal to Japan's total electricity use. Much of this demand is driven by cloud facilities that host AI models. Google and Microsoft disclosed that their data centres' water use increased by 20% and 34%, respectively, in 2022. In some regions, proposed data centres have sparked protests over the extraction of drinking water reserves.

Data quality, bias and ethical risks

GenAI's outputs are only as reliable as its inputs. EY warns that generative tools are limited by the quality and availability of data from supply chain partners. If supplier emissions data are incomplete or inaccurate, an AI driven sourcing recommendation could inadvertently favour polluting producers. Natural language models may inherit biases present in training data, potentially reinforcing inequities in supplier selection or labour practices. Strong governance, transparent data sharing agreements and human oversight are necessary to mitigate these risks.

Governance and regulation

Policymakers are starting to scrutinise AI's environmental and social impacts. In Washington, Senator Edward Markey noted that "the development of the next generation of AI tools cannot come at the expense of the health of our planet" and introduced legislation requiring the U.S.

government to assess AI's environmental footprint. The European Union's AI Act will require high risk AI systems, including generative models used in supply chains, to report their energy consumption, resource use and lifecycle impacts. At the international level, the International Organisation for Standardisation plans to issue criteria for "sustainable AI", covering energy efficiency, raw material use and water consumption. Companies deploying GenAI should anticipate stricter disclosure requirements and incorporate environmental metrics into their AI strategies.

Future outlook: integrating AI and sustainability

Delivering genuine value by 2025

KPMG predicts that in 2025, supply chain leaders will finally start to derive genuine value from GenAI investments. The technology can streamline tasks in procurement, category management, contract





management, supplier risk analysis and invoice processing. As digital twins become more prevalent, leaders will have real time visibility into supply networks and can simulate changes before implementing them. The consultancy emphasises that leaders must not only leverage technology but also adopt new cost to serve analytics, deepen visibility into Tier 4 suppliers and collaborate across ecosystems. Digital twins and predictive planning will help map supply chains, identify carbon hotspots and guide decarbonisation strategies.

Human-AI collaboration and new skills

Deloitte notes that GenAI isn't just a tech upgrade; it is a pivotal technology reshaping how companies build efficient, resilient and sustainable supply chains [50]. Real time data insights can predict disruptions before they happen, AI driven automation reduces costs and carbon emissions,

and advanced analytics turn sustainability from a goal into an operational reality. However, realising these benefits requires new skills and organisational structures. KPMG expects supply chain and procurement personnel to upskill in data analysis and AI modelling, while companies open global capability centres to leverage talent pools. EY adds that GenAI will act as a "multiplier" in what humans and technology can achieve together, enhancing planning, sourcing, manufacturing and logistics.

Balancing AI's benefits and footprint

The paradox of AI in sustainability is that it can both reduce and increase environmental impacts. On the one hand, AI optimised smart homes could reduce household CO₂ consumption by up to 40%, and AI guided flight paths could cut aviation contrails. On the other hand, the rebound effect of increased usage because of efficiency gains may

offset some of the benefits. To ensure net positive outcomes, supply chain leaders should:

1. Set dual goals – Evaluate AI projects on their ability to reduce emissions and resource use as well as improve efficiency and profitability. Establish key performance indicators (KPIs) that track carbon intensity and water consumption alongside cost savings.
2. Invest in green infrastructure – Prioritise data centres powered by renewable energy and cooling systems that minimise water use. Cloud providers are beginning to publish sustainability dashboards; companies should integrate these metrics into AI procurement decisions.
3. Promote transparency – Participate in industry initiatives to standardise reporting of AI's environmental footprint. Share data with regulators, investors and the public to build trust and meet



emerging compliance obligations.

4. Develop responsible AI governance – Adopt frameworks that address data quality, bias, privacy and accountability. Include diverse stakeholders in AI development and use independent audits to identify unintended consequences.

5. Upskill and reskill workforce – Provide training in AI literacy, sustainability metrics and ethical decision making. Encourage collaboration between data scientists, sustainability experts and supply chain managers.

Conclusion

The convergence of sustainability pressures and rapid advances in artificial intelligence is reshaping global supply chains. Generative AI offers powerful tools to optimise routes, consolidate loads, forecast demand, design products, maintain equipment and manage suppliers. Pilot projects show that AI enabled supply chains can reduce emissions and costs simultaneously. Analysts expect genuine value to emerge by 2025 as organisations move from experimentation to deployment. Yet the technology's computational hunger threatens to

undermine its sustainability promise: data centres consume enormous amounts of electricity and water, and the rebound effect could erode efficiency gains. The future of sustainable supply chains therefore hinges on responsible adoption. Businesses must pair GenAI implementation with transparent reporting, green infrastructure, robust governance and continuous upskilling. With these safeguards in place, generative AI could become a cornerstone of supply chain decarbonisation, turning sustainability from a reporting requirement into a source of competitive advantage and resilience.

Resources

Six supply chain trends to watch in 2025 -

KPMG

Mary J. Rollman

Principal, Supply Chain Leader, KPMG US

Stephanie David

Principal, Life Sciences Supply Chain, KPMG LLP

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Circular Economy Lead, KPMG LLP

Chris McCarney

Principal, Procurement & Outsourcing Advisory
Leader, KPMG LLP (U.S.)

As Use of AI Soars, So Does the Energy and Water It Requires -

Yale School of Environment - By David Berreby

How supply chains benefit from using gener- ative AI

Glenn Steinberg

EY Global Supply Chain and Operations Leader

Matthew Burton

EY EMEA Supply Chain and Operations Leader

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Generative AI for Sustainable Supply Chains: Optimising for a Greener Future

By GoComet

Generative AI in Supply Chain: Smarter Planning and Inventory Management at Lower Cost

Master of Code

By Ivan Pohrebniyak - Chief Delivery Officer

How Gen AI is transforming sustainable supply chains

Deloitte, by Tore Christian Jensen - Partner



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Managing Director
Logistics Executive

The founder of Logistics Executive Group, Kim delivers 40 years of executive leadership experience spanning Executive Search & Recruitment, Leadership Development, Executive Coaching, Corporate Advisory, Consulting & M&A, Media Interviews & Podcasts, across the Supply Chain, Logistics, 3PL, E-commerce, Life Science, Cold Chain, FMCG, Retail, Maritime, Defense, Aviation, Resources & Industrial sectors. He is a regular contributor of thought leadership to industry and media, is a professional Master of Ceremonies and is frequently invited to chair / moderate face to face international events and media platforms.

He is a Board member over a dozen companies throughout APAC, India and the Middle East, a New Zealand citizen, he holds formal resident status in Australia, Hong Kong and the UAE and is an international representative for several key UAE Government entities.



Multi-Hazard Early Warning Systems Bridge into Supply Chain Strategy

By Wolfgang Lehmacher
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Supply Chain, Logistics, Transport

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In a world where the unexpected has become the norm, the resilience of supply chain networks is no longer a luxury but a necessity. The COVID-19 pandemic, the Suez Canal blockage, the Red Sea Houthi attacks, and the increasing frequency of climate-related disasters have all highlighted the fragility of the intricate networks that sustain the global economy and our wealth and standard of living. The stakes are high: disruptions ripple across borders, impacting everything from the availability of basic goods to the stability of financial markets. In this context, the

ability to anticipate and act on emerging threats before they become crises has never been more critical. This is where Multi-Hazard Early Warning Systems (MHEWS) move from the periphery to the very heart of supply chain strategy.

The supply chain is the circulatory system of the modern world, connecting producers, suppliers, and consumers in a web that spans continents and the globe. Yet, its very interconnectedness is its Achilles' heel. A flood in Southeast Asia, a wildfire in California, or a typhoon in the Pacific can disrupt

manufacturing, delay shipments, and trigger cascading effects that reach far beyond the initial point of impact. No country can ensure the current quality of life by decoupling from the world; the consequences would be exorbitant. We are moving towards a mix of dependencies and independencies. As climate change accelerates and geopolitical tensions mount, the frequency and complexity of disruptions are set to increase. The question is not if a supply chain will be tested, but when, and how prepared it will be to respond.

Understanding MHEWS and Its Complements

Multi-Hazard Early Warning Systems are sophisticated frameworks designed to detect, monitor, and communicate risks from a range of hazards, including meteorological, hydrological, geological, and biological. Unlike traditional, single-hazard warning systems, MHEWS provide a holistic approach, integrating data from multiple sources to deliver timely, accurate, actionable information to decision-makers. At their core, these systems are built on four pillars: risk knowledge, hazard detection and monitoring, warning dissemination, and preparedness and response.

MHEWS are not standalone solutions. Their effectiveness is amplified when complemented by

advanced supply chain risk management platforms and digital technologies. Solutions like Everstream Analytics, Resilinc, and Interos leverage artificial intelligence, big data, and real-time monitoring to map supplier networks, assess vulnerabilities, and deliver targeted alerts to businesses. These platforms act as bridges, translating the broad warnings of public MHEWS into supply chain-specific intelligence, enabling companies to anticipate disruptions and act swiftly.

Furthermore, the integration of MHEWS with Internet of Things (IoT) devices, cloud computing, and mobile platforms extends their reach and granularity. IoT sensors can provide real-time data on environmental conditions at manufacturing sites or along transportation routes, which feeds into

MHEWS and enhances its predictive power. Cloud-based platforms ensure that warnings and risk assessments are accessible to relevant stakeholders worldwide, breaking down silos and fostering collaboration.

Why MHEWS Are Essential for Supply Chains

The essentiality of MHEWS for supply chain networks lies in their ability to transform uncertainty into manageable risk. In an era defined by volatility and uncertainty, the difference between resilience and vulnerability often comes down to information, its timeliness, accuracy, and relevance. MHEWS provide the early signals that allow companies to move from reactive crisis management to proactive risk mitigation.



The benefits are tangible. Early warnings enable companies to reroute shipments, adjust inventory levels, and communicate with partners and customers before disruptions escalate. They support contingency planning, resource allocation, and the protection of critical assets. In sectors where lead times are long and margins are thin, such as the automotive or electronics industries, a few hours' advance notice can mean the difference between continuity and costly shutdowns.

Moreover, MHEWS supports compliance with regulatory requirements and enhances reputational capital. As stakeholders, from investors to consumers, demand more transparency and responsibility, companies that leverage MHEWS demonstrate a commitment to risk management and

social responsibility. This not only safeguards operations but also strengthens trust and competitiveness in the marketplace.

When MHEWS are integrated into community or business operations, they can reduce the risk profile of insured assets by allowing for early action, such as evacuations, asset protection, or business continuity measures, which can limit losses and claims. Insurers can offer premium discounts or more favourable terms to policyholders who implement risk reduction measures, including those informed by early warning systems.

Gap Analysis: Where the System Falls Short

Despite significant progress, the global MHEWS landscape is marked by persistent gaps. Coverage remains uneven, with the lowest levels in the

least developed countries and small island developing states. Many regions lack the infrastructure, technical capacity, or financial resources to implement and maintain robust systems. Data integration and interoperability are ongoing challenges, as information from satellites, ground sensors, and social media must be harmonised and translated into actionable intelligence.

At the company level, the integration of MHEWS data into supply chain decision-making is often ad hoc or incomplete. Small and medium-sized enterprises may lack the expertise or resources to interpret warnings and translate them into practical action. Even among large multinationals, siloed operations and fragmented information flows can delay response times and reduce the effectiveness of early warnings.

Another critical gap is the last mile: ensuring that warnings reach those who need them, in a form they can understand and act upon. Language barriers, digital divides, and varying levels of risk literacy can all impede the flow of information. In some cases, false alarms or unclear messages can erode trust, leading to complacency or inappropriate responses.





Closing the Gaps: Pathways to Progress

Closing these gaps requires a concerted, multi-stakeholder effort. Investment in infrastructure and capacity building is paramount, particularly in vulnerable regions. Governments, international organisations, and the private sector must collaborate to expand monitoring networks, enhance data integration, and ensure that systems are maintained and updated. Open data initiatives and standardised protocols can facilitate interoperability and accelerate innovation.

At the company level, the integration of MHEWS data into supply chain risk management must become standard practice. This means embedding early warning signals into enterprise resource

planning systems, scenario planning, and decision-support tools. Training and capacity building are essential, ensuring that staff at all levels understand how to interpret warnings and translate them into action.

Public-private partnerships offer a powerful model for advancing MHEWS. By sharing data, costs, and expertise, governments and businesses can co-create solutions that serve both public safety and commercial resilience. Feedback loops, where companies report on the effectiveness of warnings and share operational data, can help refine and improve systems over time.

The Role of Companies: From Beneficiaries to Contributors

Companies are not just passive recipients of early

warnings; they can be active participants in the MHEWS ecosystem. By integrating MHEWS data into their operations, businesses can enhance their resilience and contribute to the broader system. Sharing supply chain data, participating in pilot projects, and supporting innovation all help to strengthen the collective capacity to anticipate and manage risk.

Moreover, companies can advocate for stronger MHEWS at the policy level, highlighting the business case for investment and the economic benefits of resilience. By aligning their sustainability and risk management strategies with public initiatives, businesses can amplify their impact and drive systemic change.

This means moving beyond compliance and

box-ticking to a culture of openness, preparedness, and collaboration. It means investing in technology, training, and partnerships that extend the reach and effectiveness of MHEWS. It also means recognising that resilience is not a zero-sum game: the benefits of a robust early warning system accrue to everyone, from producers to consumers, from local communities to global markets.

Conclusion: The Surprising Power of Foresight

As we stand at the crossroads of escalating risk and exploding technological capability, the value of MHEWS comes into focus. These systems are not just tools for crisis management; they are enablers of foresight, agility, and shared prosperity. In a world obsessed with speed and efficiency, it is the capacity to pause, anticipate, and prepare that also will define the winners of tomorrow. Supply chains that embrace MHEWS are not merely surviving the storms; they are learning to dance in the rain, turning risk into opportunity and uncertainty into a catalyst for performance, innovation, and growth.



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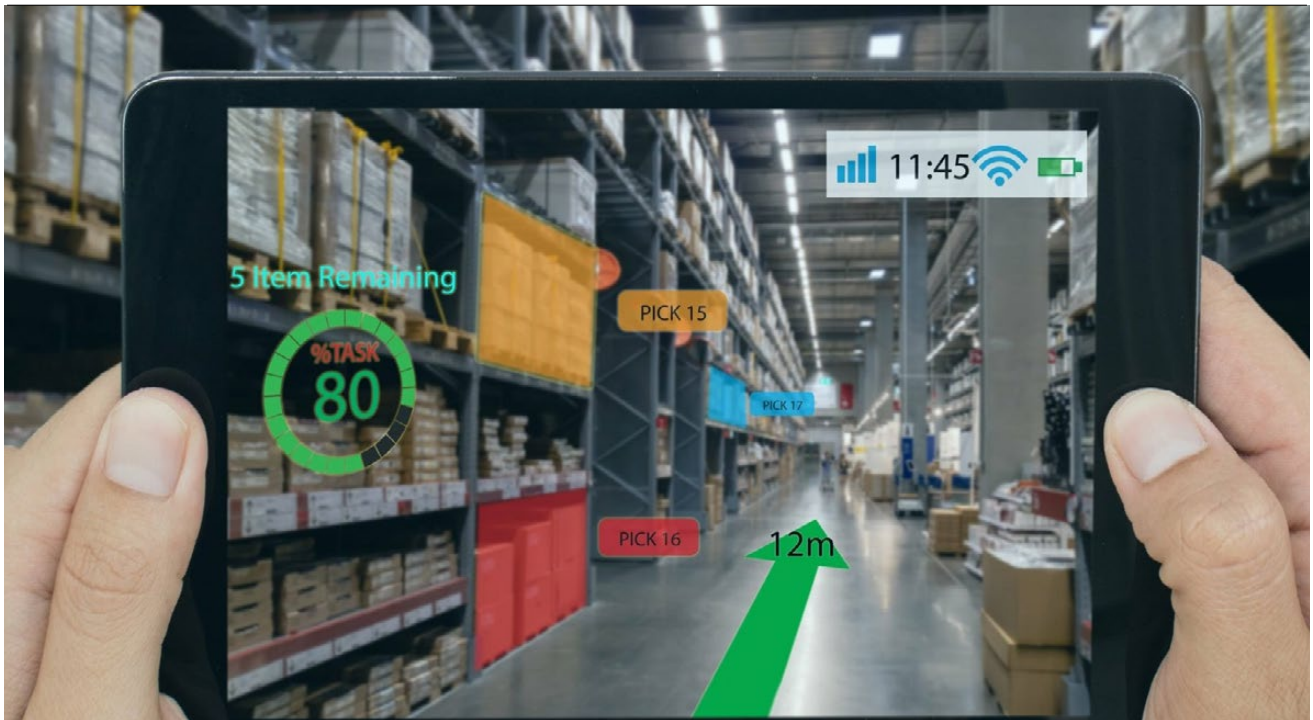
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A man and a woman are looking at a large digital screen in a modern office setting. The man, on the left, has a beard and is wearing a dark blue sweater. He is pointing at the screen with his right hand. The woman, on the right, has short brown hair and is wearing a light blue dress. She is also pointing at the screen with her right hand. The screen displays a complex network diagram with many nodes and connections, and some text on the right side. The background is a bright, modern office with large windows and a grid ceiling.

Can Generative AI Close SupplyChain's Carbon Gap—or Widen It?

By Martin Hubert
Chief Executive Officer at Freightgate



On a cool March morning, a supply chain planner opens an AI-curated daily briefing. Among the weather alerts and commodity updates, a single recommendation stands out: delay a scheduled steel order by two weeks. The large language model (LLM) behind the briefing has synthesised news of a port strike in Asia, forecast local inventory depletion, and factored in the carbon footprint of expedited freight. The planner clicks “approve”. No air freight will be needed; the order will ship by sea. The decision saves money — and avoids 14 tonnes of CO₂ emissions.

For supply chains under mounting pressure to cut greenhouse gases, moments like this hint at a powerful new tool: generative AI. Yet the technology’s own energy appetite raises an uncomfortable question —

can it truly help close the carbon gap, or is it quietly widening it?

The Sustainability Imperative

Sustainability is no longer a “nice to have” in logistics — it’s a compliance and competitiveness necessity. Supply chains are the largest slice of most companies’ climate impact, with Scope 3 emissions averaging 11.4 times the size of operational emissions.

Regulation is sharpening this focus. Australia’s mandatory Scope 3 disclosure law took effect in January 2025, while the EU’s Corporate Sustainability Reporting Directive (CSRD) and the US Securities and Exchange Commission’s climate disclosure rules are aligning global expectations. Failure to produce accurate,

auditable supply-chain carbon data now carries reputational and financial risk.

At the same time, customers, investors, and NGOs are watching closely. Amazon, for example, cut single-use plastic use by 16% in 2024 after introducing its machine-learning-driven “Package Decision Engine”— a change applauded by environmental groups and touted in investor calls.

Inside the Generative AI Toolbox

Generative AI — the family of models that create new text, images, designs, or simulations — is proving useful for sustainability in five high-impact ways:

1. Demand and Inventory Rightsizing

LLM-based copilots summarise disruption signals, run scenario simulations, and recommend adjusted order quantities. Manufacturers use this to keep inventories lean, avoiding waste and unnecessary production runs.

2. Dynamic Route Optimisation

Graph-generating and reinforcement-learning models recompute optimal transport paths in real time, factoring in emissions as well as cost and speed. Pilot projects have achieved fuel and CO₂ reductions of 10–30%.

3. Low-Carbon Packaging Design

Generative design tools rapidly iterate packaging shapes and materials, testing each against lifecycle-analysis engines. This has cut material use by up to 20% and logistics-phase emissions by 15% for consumer goods brands.

4. Scope 3 Emission Estimation

Foundation models impute missing supplier data and simulate the impact of recipe or sourcing changes. One ready-meal manufacturer achieved an 18% cut in recipe-level emissions.

5. Supplier-Risk and Modal-Shift Modelling

Multimodal Gen-AI platforms combine satellite data, market news, and ESG reports to score supplier risk and propose lower-carbon alternatives, as Unilever now does for key commodity sources.

Case Studies from the Field

Amazon's “Package Decision Engine” selects right-sized, paper-first packaging for each order. It has eliminated 500,000 tonnes of packaging material per year, and the 16% reduction in single-use plastic earned positive headlines.



Nestlé integrates predictive-demand AI with IoT-linked logistics control towers. Forecast error rates dropped by 30%, reducing both product waste and avoidable transport emissions.

Packaging sector leaders have embedded generative design into product development.

Executives report packaging development cycles that are 30% faster, with expectations of more than 6% cost savings and 8% revenue growth from sustainable product lines.

Unilever uses multimodal Gen-AI to evaluate suppliers against emissions, labour, and climate-risk metrics — enabling proactive shifts to greener, more resilient partners.

The Double-Edged Sword: AI's Own Carbon Footprint

Every one of these wins comes with a hidden cost: the compute power behind Gen-AI is carbon-intensive. Training a single large model can emit more than 500 tonnes of CO₂, and each user query consumes electricity and water for cooling. A typical 400-token LLM call generates about 1.14 g of CO₂ and consumes 45 ml of water.

Hyperscale AI data centres, some requesting 300–1,000 MW of power capacity, are already challenging national

grids. Without a shift to low-carbon energy sources, AI's climate cost could erode much of its sustainability benefit. This makes “green AI” — optimising model size, training cycles, and inference energy — a core part of any responsible supply-chain deployment.

Emerging Best Practices

At Freightgate, we've seen that the companies making tangible sustainability gains with generative AI share several practices:

1. Start with High-Emission Pain Points

Focus on projects where avoided emissions clearly outweigh AI's own footprint — air freight avoidance, waste reduction, and packaging redesign deliver quick wins.

2. Integrate Digital Twins

Combining generative scenario generation with high-fidelity digital twins improves emission modelling accuracy and reduces costly trial-and-error.

3. Audit Model Outputs for Accuracy

Inaccurate or hallucinated emissions data can undermine compliance and credibility. Human oversight remains essential.

4. Measure AI's Own Carbon and Water Use

The emissions from AI infrastructure must be visible in the same way freight emissions are.

5. Build Cross-Functional Capability

Risks and Ethical Considerations

Generative AI is not without pitfalls. Optimising purely for carbon might drive production to regions with weaker labour protections. Supplier risk scores may unintentionally favour large incumbents over innovative SMEs. And over-reliance on AI-generated recommendations could erode human situational judgement.

The answer is to embed environmental, social, and governance (ESG) principles into the model objectives and maintain a human-in-the-loop decision process.

What Good Looks Like

When deployed responsibly, generative AI can become a force multiplier for sustainable supply chains. The winning formula:

- **Governance First** — Clear ownership of data quality, model outputs, and emissions metrics.



• **Green Compute** — Selecting renewable-powered data centres and right-sized models for the task.

• **Evidence Before Expansion** — Scaling only after measurable emissions reductions are demonstrated.

With this discipline, generative AI can help supply chains become more carbon-intelligent — making smarter, faster, and greener decisions at scale.

Conclusion

Generative AI's real promise is in precision: targeting the most carbon-intensive decision points with models tuned for both sustainability and efficiency. The vision is a future where every prompt, simulation, and forecast is measured not just for cost and service but for its climate impact.

At Freightgate, we believe the leaders of tomorrow's supply chains will be those who wield AI as both a scalpel and a compass — cutting waste, guiding strategic choices, and steering global trade toward a net-zero horizon.



Martin Hubert
CEO at Freightgate

Martin Hubert is the CEO of Freightgate, a global leader in cloud-based logistics solutions. With over two decades of experience driving digital transformation in freight management, Martin is a recognised innovator in applying technology to create more resilient, efficient, and sustainable supply chains. He is a frequent contributor to industry conferences and publications, shaping the dialogue on the future of logistics and global trade.



Narrow-body aircraft leading the way toward greater energy efficiency in the air cargo industry





The role of narrow-body freighters in the air cargo industry has progressed quickly in recent years, largely due to the introduction of new-generation freighters tailored to meet current logistics demands. Certain aircraft, like the Boeing 737-800 and Airbus A321-200, have been introduced with more fuel-efficient engines and optimised cargo configurations, making them ideal for short- to medium-haul operations while at the same time reducing significant environmental impact.

Due to the worldwide demand for greater efficiency and sustainability in industrial operations, these planes offer reduced fuel usage alongside quicker turnaround times, rendering it feasible to move small quantities across short distances.

Creating more energy-efficient global operations

Aside from the fact that narrow-bodies are generally considered more sustainable and cost-effective due to their passenger-to-cargo aircraft conversion flexibility, their environmental benefits are another important factor. Operating a smaller aircraft on short- and medium-haul routes reduces fuel consumption per trip and easily caters to a wide range of industries, such as e-commerce and perishables, that require a quick turnaround at a lesser space capacity.

New-generation narrow-body aircraft, such as the Boeing 737-800 and Airbus A321-200, take this efficiency to the next level. These new models are designed with advanced, fuel-efficient engines, improved aerodynamics, and lighter composite materials, resulting in significantly lower fuel consumption compared to older aircraft models. These improvements

reduce greenhouse gas emissions, lower operational costs, and help operators meet stricter environmental regulations.

With the introduction of new aircraft models, this makes narrow-bodies a more sustainable and competitive choice for certain markets with regional proximities and for organisations with a strong commitment to greener operations.

Narrow-bodies do not create a competition against the wide-bodies; they complement them.

It's generally known that both wide-bodies and narrow-bodies were designed to serve different purposes and serve different target markets. While wide-body freighters connect major global hubs and handle high-volume, long-haul shipments, narrow-bodies allow access to secondary airports and smaller markets with speed and efficiency.

These narrow-body aircraft serve as a regional feeder service, allowing operators to efficiently move cargo from smaller airports to major international hubs. For areas where there are limited flexibilities, this service allows the movements of shipments.

This balance between wide-body and narrow-body creates a more connected,

flexible, and efficient system that meets diverse needs of the market while maximising reach, speed, and reliability.

Regional trends with new generation aircraft

In Europe and the Middle East, narrow-body freighters have become an increasingly important part of the cargo industry. New-generation freighters like the Boeing 737-800 and Airbus A321-200 are playing an important role in regional operations, as they are designed to be more fuel-efficient, have lower emissions, and offer the flexibility to run flights between busy trade hubs within the region where infrastructures are highly developed and the demand is consistently high.

Meanwhile in Africa, narrow-body presence has been consistently growing in the previous years but still remains more limited due to some geographical dynamics and limited airport infrastructure. However, narrow-bodies are slowly carving out their place as new freighter models are being introduced to the market, allowing more cargo volume and longer range compared to existing freighters in service.

Magma leverages decades of regional market expertise, creating more lucrative opportunities.

As global demand for regional and long-haul cargo continues to grow across several industries, Magma Aviation understands how to integrate narrow-body

aircraft into a global network in a way that complements wide-body operations. With the strategic combination of both, Magma offers customers better connectivity with faster, tailored, flexible, and more sustainable transport solutions.

Honed by almost two decades of extensive global experience, Magma's global team continues to offer tailored global freight solutions, helping businesses across the globe transport their goods effectively and efficiently.

About Magma Aviation

Magma Aviation, the innovative air cargo solutions company, is renowned for its forward-thinking approach to global cargo operations.





With its headquarters in Dublin and strategic hubs in Dubai and Gatwick, Magma Aviation is well-positioned to take a significant leap in operational efficiency and market coverage. The company is part of Avia

Solutions Group, the world's largest ACMI (Aircraft, Crew, Maintenance, and Insurance) provider. The group, which operates a fleet of 209 aircraft worldwide, is the parent company to over 250

subsidiaries. The group also provides a range of aviation services: MRO (Maintenance, Repair, and Overhaul), pilot and crew training, and ground handling, as well as a variety of associated aviation services. Supported by 14,000 highly skilled aviation professionals, the group operates on 6 continents.



Magma Aviation was launched in 2010 to commercially and operationally manage dedicated wide-body cargo aircraft, contracted on an exclusive basis from airline partners.

The senior management team at Magma Aviation is comprised of air cargo specialists and aviation professionals. Magma Aviation is a Chapman Freeborn company and a family member of Avia Solutions Group, the world's largest ACMI (Aircraft, Crew, Maintenance, and Insurance) provider, operating a fleet of 209 aircraft on 6 continents.

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Kardex's new AutoStore StarterGrid meets the need for fast, scalable, affordable warehouse automation.

kardex

The AutoStore StarterGrid, exclusively designed and configured by Kardex, is an affordable, efficient, ready-to-deploy automation solution to supercharge storage and fulfilment operations. Singapore, 07 Aug 2025 – Global intralogistics specialist Kardex has unveiled its new AutoStore™ StarterGrid, which is an affordable, plug-and-play automated storage and retrieval system (ASRS) now available to customers in Southeast Asia. It immediately streamlines storage and fulfilment operations and is targeted at startups, small and medium-sized businesses, and companies wanting to test the impact of automation on their

warehouse operations. Kardex, the world's fastest-growing AutoStore integrator, has exclusively designed and configured the 4,000-bin system to provide customers with the chance to embrace warehouse automation without complexity, high costs or long lead times. It provides the ideal starting point for automation, as it is easy to install and built for simplicity.

AutoStore StarterGrid: Scalable, precise, and maximising warehouse space AutoStore is the world's fastest goods-to-person (GTP) system per square metre and maximises space efficiency, reducing warehouse footprint

by over 50% and increasing storage capacity. The AutoStore StarterGrid from Kardex can be installed into existing facilities without costly adaptations or power upgrades.

Precise AutoStore robots can boost picking accuracy up to 99%, and throughput can double or even triple compared with manual operations. In addition, the AutoStore ASRS solution enhances warehouse safety and carries out mundane, physically demanding and repetitive tasks, freeing workers up to carry out more rewarding work. Designed with scalability in mind, the Kardex AutoStore StarterGrid can be easily

expanded without disrupting business operations or requiring any rework, with new ports and robots added swiftly to meet surges in demand. As company needs grow, the grid can even be customised by Kardex to meet evolving requirements.

A 4,000-bin ASRS solution within 6 months

The AutoStore StarterGrid from Kardex offers a standardised, pre-configured setup featuring all the essential components to start automating quickly and efficiently. It is simple and hassle-free to implement, comprising a compact, high-density grid frame of up to 6 metres, 4 R5 robots for fast, accurate item retrieval, 4,000 storage bins, and 2 efficient conveyor ports for precise order picking – handling 180 to 240 bins per hour with 99% accuracy.

Return on investment (ROI) for the new solution is 2-3 years on

average, and businesses can reach out to Kardex to find out more, with a dedicated project team providing expert end-to-end guidance to unlock the benefits of automation within 6 months.

Kardex: An expert AutoStore integrator and innovator
Businesses that want to find out more about the impact AutoStore could have on their operations can visit Kardex's new office and Experience Centre in Singapore. The new facility, recently opened in the Nordic European Centre at the International Business Park, positions Kardex for further growth in Southeast Asia and provides a dedicated space for customers to meet with the expert team and see firsthand how AutoStore systems powered by Kardex can revolutionise their operations. Kardex also has the most extensive portfolio of exclusive products designed to enhance

the AutoStore system. These include the purpose-built FulfillIX warehouse execution system (WES), designed to streamline operations and enhance performance; the Intuitive Picking Assistant (IPA), which guides operators through the picking process by projecting all relevant information to optimise picking efficiency and accuracy; and the SnapVac cleaning robot to keep the AutoStore grid free from dust, debris, and operational slowdowns.

Freddy Zhong, APAC Director of Business Development for AutoStore, says, "Smarter automation starts with smart prices. The AutoStore StarterGrid from Kardex provides companies of all sizes with automation that's practical for today AND prepares them for tomorrow. We want to get through to the people who think that warehouse automation is not for them or is



too expensive. The StarterGrid has been specially designed for companies that want to improve their storage and fulfilment operations with a solution that is fast to implement, scalable and efficient.”

This StarterGrid is a fixed,

preconfigured package. However, businesses can get a personalised cost estimate and ROI projection in under 5 minutes using Kardex’s unique StoreX Calculator.



kardex

About Kardex

Kardex is a leading global partner for intralogistics solutions in an attractive and growing market. The Group offers premium automated products, standardised systems and lifecycle services that guarantee high availability and low total cost of ownership. Kardex provides an intelligent entry into automation with its dynamic storage and retrieval systems, offers integrated material handling systems and small parts storage systems, and acts as a global AutoStore partner, offering flexible and modular storage and order fulfilment solutions. The Group employs around 2,500 people in over 30 countries. Kardex Holding AG has been listed on the SIX Swiss Exchange since 1989.

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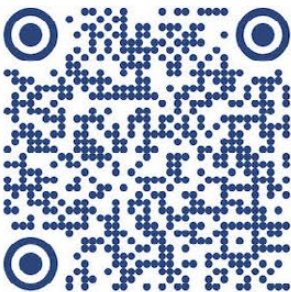
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Consumers trust recommendations from third parties more than they trust a brand itself. 70% of people will trust a review from a complete stranger as opinions and recommendations are by and large more influential when they do not come from the source itself. Additionally, most marketers include company logos and testimonials as proof on materials pages to strengthen trust and influence visitor behaviour.

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- ✓ Industry led symposiums across the region
- ✓ Surveys & survey analysis
- ✓ Advertisements in two of the largest circulation supply chain publications
- ✓ Online articles
- ✓ Content syndication
- ✓ White label reports and thought leadership articles
- ✓ eDMs
- ✓ Social media – LinkedIn, Facebook, You Tube



When working on the Influencer / Platform Partnership, partners have the opportunity to choose which options they feel will give them maximum reach and success and planning and pricing will be structured along the desired activities. Contact Harjeet@logisym.org for more information.