Advancing Decarbonization through Energy Efficiency at İGA İstanbul Airport

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Towards a Low-Carbon Future: iGA's Energy Efficiency Vision

As the aviation sector faces growing pressure from climate change and the energy transition, iGA Istanbul Airport embraces its role as a frontrunner in shaping a low-carbon future. Strategically located at the crossroads of continents and cultures, iGA is not only a transportation hub but also a platform for innovation and responsibility. Energy efficiency, for iGA, is not a narrow technical objective but a foundational principle driving broader environmental, economic, and social transformation.

To support the International Civil Aviation Organization's (ICAO) Long-Term Aspirational Goal (LTAG) of net-zero carbon emissions by 2050, iGA has adopted energy efficiency as a core strategy. This approach extends beyond operational improvements to encompass governance, technology, and behavioural change, contributing directly to the United Nations Sustainable Development Goals (SDGs), particularly SDG 7, SDG 9, and SDG 13.

iGA's decarbonization roadmap aligns with ICAO's LTAG, setting interim goals to reduce emissions by 45% by 2030 and 73% by 2040. Yet, it is not targets but the systemic integration of sustainability, into infrastructure, training, operations, and partnerships, that drives lasting impact.

Through investments in real-time analytics, electrification, sustainable architecture, and behavioural, approaches, iGA is advancing a greener, smarter, and more human-centred airport model. This article outlines our journey and aims to contribute insights to the global aviation community. Realizing sustainable aviation, we believe, requires ambition, collaboration, and persistence, principles to which iGA remains firmly committed.

Governance and the Strategic Energy Framework

iGA Istanbul Airport's decarbonization strategy is guided by an integrated sustainability governance model grounded in ISO 50001-certified energy management. A cross-functional Sustainability Committee, chaired by senior executive leadership, convenes quarterly to align strategic planning with climate objectives. All major investments are subject to lifecycle-based assessments, evaluating energy intensity, mitigation potential, and adaptive capacity.

Real-time energy data informs capital investment and procurement decisions, embedding energy efficiency into broader development strategies. This systemic approach treats sustainability not as an isolated goal but as an integral component of institutional decision- making.

iGA's progress is externally validated. The airport advanced from Level 3 "Optimisation" to Level 4 "Transformation" in the Airport Carbon Accreditation (ACA) programme between 2022 and 2023, reflecting strengthened management of Scope 1 and 2 emissions and increased influence over Scope 3 through stakeholder engagement. Additionally, 2024 CDP ratings—"B" for Climate Change and "A–" for Water Security—demonstrate enhanced performance in risk governance and disclosure.

Integrated Action: Key Measures for Energy Efficiency and Decarbonisation

To advance its energy transition, iGA has implemented a coordinated programme focused on three strategic areas: infrastructure, digital energy systems, and mobility. These integrated efforts reflect current best practices in airport energy management and these initiatives aim to deliver both environmental benefits and operational efficiencies.

- Renewable Energy Deployment: Supported by a €200 million clean energy investment plan, iGA has launched a phased solar photovoltaic (PV) programme to decarbonize its electricity consumption. The initial phase, currently underway, includes rooftop and parking-structure installations, generating over 10 MWh in 2024—covering approximately 20% of annual electricity demand. A large-scale utility solar farm in development is expected to produce 340 GWh annually, enabling full renewable electricity coverage for terminals, auxiliary buildings, and future expansions.
- Digital Optimisation via IoT: With over 3,000 IoT sensors integrated through a LoRaWAN network, iGA monitors energy use in real time across lighting, HVAC, escalators, and security systems. Predictive analytics are employed to manage peak loads and optimize equipment cycles.
- Building Energy Performance Enhancements: Campus-wide retrofits have introduced intelligent LED systems with occupancy and daylight sensors, reducing lighting energy use by 32% compared to 2019. Upgrades in glazing, insulation, and automated blinds have further reduced heating and cooling loads by 18%, enhancing thermal efficiency and indoor comfort.
- Electrification of Ground Operations: iGA currently operates over 100 electric ground vehicles and targets 50% fleet electrification by 2030. Diesel ground power units at contact stands have been replaced with electric alternatives (e-GPUs), contributing to emissions reduction on the airside.

Data-Driven Impact and Emissions Trends

Despite passenger volumes increasing by 34% between 2019 and 2023, iGA achieved a 25.6% reduction in Scope 1 and 2 emissions. This decoupling was made possible through aggressive energy efficiency efforts and renewable energy integration. Annual electricity savings reached 28 GWh, preventing over 12,000 tons of CO_2 emissions.

Carbon accounting is embedded into airport operations which maintains a real-time carbon dashboard and use CDP-aligned reporting protocols. Airport's (A-) score in CDP's Climate Change 2023 assessment underscores transparency and ambition (CDP, 2023).

Resilience, Innovation, and Culture

At iGA, energy efficiency is approached as a dynamic process of organizational learning and adaptive capacity-building, rather than a solely technical objective. Recognizing the critical role of human factors in systemic change, iGA mandates annual climate literacy training and embeds behavioural change approach into internal communications. These initiatives contribute to approximately 8% of total energy savings, highlighting the operational value of employee engagement.

Organizational resilience is further supported by structured protocols and adaptive infrastructure. The Meteorological Emergency Committee (MADKOM) enables anticipatory energy management during extreme weather, marking a shift toward proactive risk governance. Architectural features such as green roofs, automated shading, daylight harvesting, and regenerative transport systems enhance passive energy efficiency and thermal regulation.

In parallel, pilot projects aligned with Türkiye's national smart grid strategy and on-site battery storage integration are underway. These technologies enhance operational flexibility by enabling real-time energy balancing and reducing exposure to grid instability. Together, these behavioural, procedural, and technological measures constitute a holistic model of energy resilience tailored to the complex requirements of large-scale airport operations.

Scaling Sustainability: Partnerships and Ecosystem Engagement

iGA Istanbul Airport plays an active role beyond its core function as an aviation hub, contributing to the development of a broader green ecosystem. In this context, the airport collaborates with national utilities, mobility providers, and academic institutions. Partnerships with Türkiye's leading universities support early-stage ventures focused on energy storage, green hydrogen, and digital twin technologies—key enablers of next-generation airport infrastructure.

The airport shares methodologies and outcomes with peer airports in the region and contributes to international dialogue through platforms such as the ICAO Global Aviation Dialogues. Internally, the Climate Ambassador Program empowers employees to act as sustainability champions, fostering a culture of climate awareness within the organization and the wider aviation sector.

In parallel, efforts continue to explore the synergy between energy efficiency and sustainable mobility. The multimodal ground access strategy prioritizes electric public transport, autonomous shuttle pilots, and low-emission corridors for passengers and staff. These initiatives are designed to reduce Scope 3 emissions and enhance the overall sustainability of the airport journey.

Circularity and Materials Efficiency

At iGA, energy efficiency is conceived within a broader material and resource circularity framework. Terminal and infrastructure upgrades are guided by life-cycle assessment methodologies, prioritising the use of low-embodied-carbon materials and circular construction approaches. This includes increasing integration of recycled aluminium, sustainable concrete substitutes, and modular building components—each selected to minimise environmental footprint while enabling adaptability in future expansions.

In parallel, iGA has initiated waste heat recovery pilots to support auxiliary operations such as pre-conditioned air systems. These systems serve dual purposes: reducing primary energy demand while capturing thermal energy that would otherwise be lost, thereby aligning with SDG 12 (Responsible Consumption and Production).

Water circularity forms a critical dimension of this strategy. A 15,000 m^3/day advanced wastewater treatment facility, supported by reverse osmosis technologies, enabled reclaimed water to supply 27% of the airport's total demand in 2024. Looking forward, a struvite recovery programme aims to recover phosphorous and nitrogen nutrients from aircraft wastewater to meet 20% of the airport's fertiliser needs. This closed-loop approach exemplifies how energy, materials, and water systems can be interwoven into a regenerative airport operations model.

Learnings and Global Recommendations

iGA Istanbul Airport recognises collaboration and knowledge exchange as key enablers of its decarbonisation strategy. Partnerships with institutions such as TÜBİTAK MAM and İTÜ ARI Teknokent support climate risk modelling and the testing of emerging technologies, including green hydrogen and battery storage. Engagement in ICAO's Global Aviation Dialogues and regional platforms enables iGA to contribute to policy development and sectoral learning.

Internally, the Climate Ambassador Programme fosters organisational learning by empowering employees to integrate climate awareness into daily operations. This reflects a broader commitment to aligning technological innovation with cultural and governance transformation.

From this experience, iGA proposes five guiding principles for global stakeholders:

1. Integrate energy into strategic planning — Energy considerations should inform core business and financial decisions.
2. Utilise real-time, actionable data — Tools like digital twins and predictive analytics are essential for adaptive energy management.
3. Balance capital and operational efficiency — Combining infrastructure investment with efficiency gains enhances long-term value.
4. Empower people — Organisational culture plays a critical role in accelerating or hindering climate goals.
5. Collaborate across the value chain — Scope 3 decarbonisation requires coordinated action with external partners.

These principles are iterative and practice-driven. iGA remains committed to refining and sharing its approach to support global net-zero aviation efforts.

Conclusion: From Efficiency to Transformation

iGA Istanbul Airport demonstrates that energy efficiency, when embedded into governance, design, and operations, becomes a powerful lever for sectoral decarbonisation. With a 25.6% reduction in Scope 1 and 2 emissions and a 32% drop in lighting energy consumption, our progress reflects a strategic and systems-oriented approach rather than isolated interventions. These achievements underscore our alignment with ICAO's Long-Term Aspirational Goal (LTAG) and the Sustainable Development Goals, particularly in climate action and infrastructure resilience. As one of the world's leading aviation hubs, we are not only responding to the climate challenge—we are shaping the pathway forward. By combining data- driven optimisation, stakeholder engagement, and long-term vision, iGA continues to advance confidently toward a net-zero future, setting a benchmark for sustainable transformation in global airport operations.

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