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## Advancing Graphene for Commercial Applications: Enhancing HVAC Filters for Sustainable Indoor Air Quality in Abu Dhabi Office Buildings

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Graphene, despite its promising properties, has faced significant challenges in commercialization over the past two decades. Issues such as scaling production, developing disruptive products, market demand, regulatory hurdles, and economic feasibility have limited its widespread adoption. This study explores the application of a proprietary silver-graphene oxide (AgGO) formulation which is produced on a large scale for treating HVAC in-duct air filters, and theoretically enumerates its performance in Abu Dhabi office buildings.

The AgGO-treated MERV-A 9-A (M9AZG) filters (Figure 1) provide an average pathogen removal efficiency of 67% over six months [1], outperforming untreated filters with similar ratings. This improved performance is attributed to enhanced mechanical filtration mechanisms such as interception and diffusion, driven by the surface properties of the AgGO. The AgGO on the filter fibres increases the surface area and also creates a rugged topography that aids in capturing smaller particles like infectious aerosols. The results suggest that AgGO enhances filtration without increasing pressure drop, providing a more energy-efficient solution, along with enhanced protection from pathogens for maintaining indoor air quality (IAQ).

In the context of the UAE's goal of achieving net-zero emissions by 2050, the building sector is critical, which contributes about 28% of greenhouse gas emissions [2]. Abu Dhabi, with approximately 46 million square feet of office space [3], could save \$9.8 million annually by replacing MERV 13 filters with M9AZG filters. This stems from fewer filter replacements, reduced waste, and lower energy costs. Additionally, this would result in 45% energy savings and reduce CO<sub>2</sub>eq emissions by approximately 5,050 tonnes per year. This aligns with the UAE's 40% CO<sub>2</sub>eq reduction target by 2030, demonstrating that graphene-based air filtration technologies can help decarbonize buildings without additional equipment installations or modifications, offering both sustainability and health benefits for a wide range of sectors, including commercial buildings, retail spaces, and institutions of all sizes.

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### References

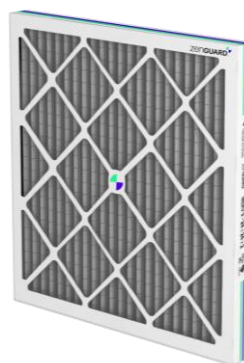
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- [1] D. Sridhar et al., ASHRAE Trans., vol.130 (2024).
- [2] Emirate GBC, UAE Sustainability Built Environment Blueprint (2023).
- [3] Knight Frank, Abu Dhabi Office Market Review (2022).

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### Figures

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**Figure 1:** M9AZG (ZenGUARD™) filters used in the experimental evaluation.

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