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OPINIONS

Embracing digital mindsets to ensure a sustainable future

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The 19th Asian Games astounded global audiences with an opening spectacle that showcased stunning digital fireworks (International Olympic Committee, 2021; Zhe, 2023). The groundbreaking display was brought to life through virtual reality (VR) and augmented reality (AR) technologies. It sets a pioneering example to replace conventional fireworks in major international events as well as in other large-scale entertainment activities, marking a historic milestone in the pursuit of a sustainable and healthy future.

Conventional fireworks emit large amounts of pollutants (Fig. 1), including toxic heavy metals, microplastics, particulate matter, and greenhouse gases (GHGs), all of which pose significant threats to the environment, animals, and humans (Devereux et al., 2022; Mukherjee et al., 2022). For example, the amount of GHGs and pollutants released by the fireworks show for Independence Day is equivalent to that produced by a 2700-acre wildfire (Sabin, 2017). In addition, noise and light pollution impair wildlife, including migratory and reproductive behaviors of birds, imposing long-term population impacts (Bateman et al., 2023). These highlight the need for a swift transition to a greener firework industry (Kalashnikov et al., 2022).

Digital fireworks in the Hangzhou Asian Games 2023, together with the ongoing efforts to formulate greener firework alternatives like the Tokyo Summer Olympics drone-swarm light show (International Olympic Committee, 2021; Zhe, 2023), may revolutionize the global fireworks market to combat its negative environmental impacts. Replacing conventional fireworks with green alternatives, therefore, can contribute to carbon reductions in the fast-growing fireworks industry and achieve net zero GHG emissions in the near future. At the same time, these efforts to formulate net-zero green firework alternatives can also mitigate noise and light pollution to reduce adverse effects on the environment as well as on sensitive wildlife such as greylag and pink-footed geese (Kölzsch et al., 2023).

More importantly, it exemplifies the potential of government-oriented embracing digital mindsets (EDM). While EDM has been highlighted by pandemic-forced lifestyle changes that facilitate carbon neutrality and sustainability, its continuance remains uncertain. For instance, the shift from in-person to virtual meetings has shown the potential to reduce carbon footprints by as much as 94% (Tao et al., 2021). However, such a trend quickly reversed after the pandemic, as revealed by the 2023 Global Meetings and Events Forecast (Tejado, 2023). The challenge lies in transforming these imposed mindsets into proactive EDM practices because technological advances alone cannot incubate sustainable and green lifestyle transitions and beyond. Now, Asian Games 2023 is taking the lead and providing insights into navigating these transitions.

Policymakers should integrate EDM principles into policy-making processes to drive technological innovations that can imbue sustainability into every facet of daily life. By providing economic incentives, as well as implementing penalty measures such as green tax (Nunes et al., 2022; Shaffer et al., 2021), EDM-embedded policies can play a pivotal role in raising social awareness of anthropogenic activities with high environmental impacts,

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Fig. 1 A firework display at the harbor of Lubec, Maine. The dusk sky, water and boats provided a beautiful setting for the colorful show. However, the smoke generated by fireworks is also visible above boats and in the air. Credit: Photo by Ray Hennessy on Unsplash.

thus facilitating lifestyle transitions. A typical example is the shift from gas-powered cars to electric vehicles, which is greatly accelerated by the new energy vehicle policy (Nunes and Woodley, 2023). Importantly, life-cycle assessments should be conducted for such alternatives (Nunes and Woodley, 2023; Zhang et al., 2023). Establishing international standards and developing infrastructures for greener fireworks should be prioritized to fulfill such assessments. All these efforts are to ensure that proposed alternatives are truly green, thus protecting the environment while still offering the convenience and joy of daily life.

The world is on a trajectory to breach the critical 1.5 °C warming threshold with a possible collapse of biodiversity and ecosystems, underscoring the imperatives of rapid EDM transitions to advance a sustainable, healthy future. These transitions, co-driven by technical progress, social awareness, and government engagement, are promising to mitigate lifestyle emissions, equivalent to two-thirds of global GHG emissions, as reported in the Emissions Gap Report 2020 (UNEP, 2020). Moreover, these endeavors will, in turn, catalyze EDM deployment and foster more equitable, low-carbon lifestyles at the individual level to protect the environment, wildlife, and humans, and ultimately achieve sustainable development goals (SDGs) set by the United Nations (Abrahms, 2021).

Conflict of Interests The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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