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FLYING CARS AND THE FUTURE IN CITIES

Relevant for: Science & Technology | Topic: Science and Technology- developments and their applications and effects in everyday life

A prototype “flying car” developed by Boeing from 2019. | Photo Credit: HO

The story so far: As climate change concerns take centre stage and the world tries out cleaner energy options, four companies commercialising urban aircraft have gone public, loading themselves with a war chest to go through the challenging certification process. Over 30 or so companies are running demonstration programmes across the globe (Joby, KittyHawk, Archer and so forth in the U.S., Lilium, Heart Aerospace in Europe, eHang in China, ePlane in India).

Flying cars, technically known as vertical take-off and landing aircraft, can take off vertically from the top of a building much like a helicopter, then shift to cruise like a conventional plane and then land vertically.

Two key breakthrough technologies, decades in the making, have enabled this. The first is going electric —aviation has always had a weight problem in using battery-power for propulsion. Li-ion batteries have been steadily progressing at a rate of about 5% per year and finally, we are reaching an inflection point where compelling urban aircraft is possible. By going electric, a second breakthrough propulsion concept is enabled —distributed electric propulsion. The approach is to spread the electric motors throughout the aircraft enabling improved performance in energy efficiency, noise levels and handling performance.

The year 2021 was a turning point for flying cars. The vision that is being sold is urban aircraft jettisoning passengers across a city in so-called flying taxis. For sustainability enthusiasts, this raises a natural question: can this be a sustainable solution for urban mobility? Sustainability is closely linked to how much energy is consumed by the aircraft and where that energy comes from. To think about the energy efficiency of aircraft and compare it to ground-based alternatives like cars, we can consider the energy required to transport one passenger across two points in a city. If we assume the distance between the two points is 5 kilometres, then a medium-sized sedan would consume about 1 kWh (1 unit of electricity). A natural question is how much energy would be consumed to travel that same distance in an urban aircraft? Your intuitive guess is likely to be much more. We unpacked the counter-intuitive answer to this question in a publication in the *Proceedings of the National Academy of Sciences*. A well-designed urban aircraft can exploit cruising using fixed wings of the aircraft at a very low energy consumption —think gliders and how they consume no energy at all. An urban aircraft can cover the same 5 kilometres in as less as 0.6 kWh for small urban aircraft and a touch over 0.9 kWh for slightly larger ones.

The interesting aspect of this comparison doesn’t stop there. The travel time for the urban aircraft can be about two to six times faster than the car, because there will not be as much traffic in the sky in the beginning.

The optimistic take gives the impression that one can hop on an urban ride across the city tomorrow. Not quite, the last missing piece is to be able to reliably make these trips for many thousands of flights to make the economics work. Critical to this is the life of the batteries that power the aircraft. All of us are familiar with the degrading performance of Li-ion batteries in laptops, smartphones and electric cars. In an urban aircraft, there is one additional twist: unlike how consumers accept their videos streaming slower on older battery-powered phones, urban aircraft cannot take-off and land differently as their batteries age. The need to take-off and land

vertically imposes a high power requirement, which sets the safety-critical limit for the operation. Given the rapid rate of progress with batteries, it is only a matter of time before we enter the Jetsonian age, where we can skip traffic and travel across metropolitan cities in a matter of minutes for trips that take hours today. Apart from the travel speed, the aircraft will fly at much lower emissions than the internal combustion engine cars today and on par or better than electric vehicles.

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The chips are Intel's first effort in many years in the market and will take on leader Nvidia, which had graphics chips sales of $9.8 billion in its most recent fiscal year, a 29% increase.

The concept car uses less than 10 kWh of electrical energy to travel 100 km. When translated into fossil-fuel consumption, this is around 1 litre per 100 km.

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