

Aerospace & Defense Practice

Short-haul flying redefined: The promise of regional air mobility

Innovative propulsion and flight-control technologies, combined with a better customer experience, could usher in a new era of frequent, convenient passenger flights on small regional aircraft.

This article is a collaborative effort by Lukas Brink, Ryan Brown, Sarina Carter, Axel Esqué, Benjamin Meigs, and Robin Riedel representing views from McKinsey's Aerospace and Defense practice.



Why drive to your neighboring city or region when you can fly? Over the past 30 years or so, the standard response has been because driving is cheaper, more convenient, and probably faster door to door. That may not be true for much longer, however. Advances in aerospace technology, new attitudes about travel, and a growing ecosystem of established players and startups could drive a resurgence in regional air mobility.

In 2019, air travel accounted for just 4 percent of all journeys between 150 and 800 kilometers in the European Union and 8 percent in the United States, with most of these flights involving large commercial aircraft (Exhibit 1).¹ The business of operating smaller regional aircraft is challenging; this market has substantially declined in recent years despite strong demand for air travel overall. Since 2004, flights on aircraft with six to 50 seats declined from 16 percent of available seat kilometers (ASK) on regional routes to just 4 percent in 2019.² This decline has led to small airports losing service, hurting access to rural communities.³

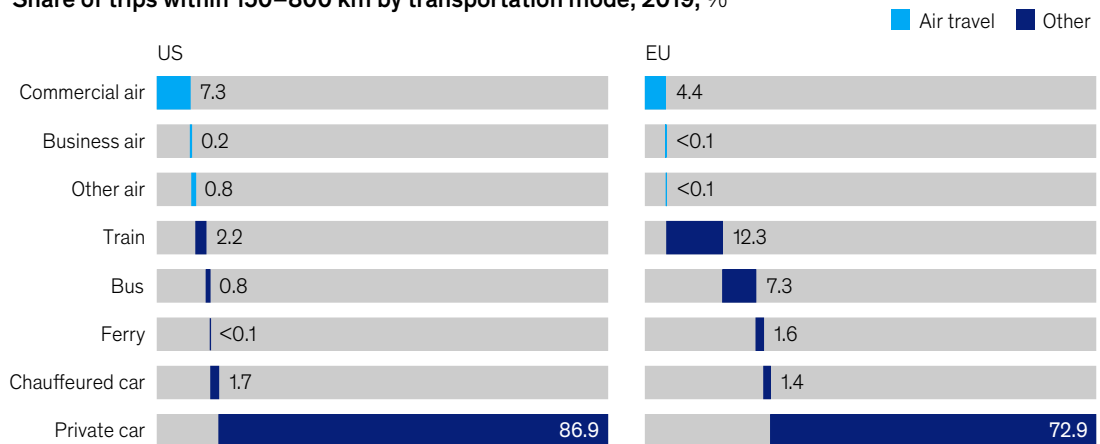
These numbers may soon change, however, because of four converging megatrends that might spur demand for regional flights and make the economics more attractive—significant technology advances, a greater focus on sustainability, growing frustration with road and airport congestion, and the emergence of mobility-as-a-service. These trends could fuel a new aviation paradigm, termed regional air mobility (RAM), which could lead to a resurgence in short-range flight.

RAM brings together new aviation technologies and existing small airport infrastructure into a transportation model that is more equitable, more economical, and more environmentally friendly for air travel over short distances, compared to today's status quo. If these changes materialize, the total addressable market (TAM) for small regional flights globally could be \$75 billion to \$115 billion by 2035, representing 300 to 700 million passengers annually.

Exhibit 1

Air travel accounts for only a small percentage of trips between 150 and 800 km.

Share of trips within 150–800 km by transportation mode, 2019, %



Note: Figures may not sum to 100%, because of rounding.
Source: Flightradar24, OECD, Eurostat, National Household Travel Survey

¹ Eurostat transportation statistics, March 20, 2023; Flightradar24 database, March 20, 2023; National Household Travel Survey, March 20, 2023.

² Cirium Diiio Mi database, March 20, 2023; commercial aircraft, 150 to 800 kilometer trips.

³ Liz Crampton, "Rural America dips into its wallet as airlines drop service," *Politico*, April 26, 2023.

The emergence of the RAM market is not a foregone conclusion. It will require several critical enablers: a seamless customer experience, more mature aircraft technology, public acceptance, and new energy infrastructure at small airports, as well as a substantial increase in the regional fleet size.

The rise of a new regional transportation model

We define RAM as the transportation of passengers and goods by air over about 150 to 800 kilometers on five- to 50-passenger aircraft (or the equivalent size for cargo), primarily using smaller regional airports.

RAM is enabled by a broad range of modern technologies, such as green propulsion, digitization, and autonomy, which will reduce costs, boost reliability, and improve customer experience. This article focuses on the passenger market, although regional cargo flights also offer interesting opportunities. RAM is adjacent to the more widely discussed urban air mobility (UAM), but is different in a few important ways. UAM is focused on shorter, intra-urban distances below 150 km and involves primarily electric vertical takeoff and landing (eVTOL) aircraft. RAM will primarily use runways, generally at smaller regional airports. It typically will not require new landing sites in or near dense urban cores, while UAM will. Similar to UAM, many RAM aircraft will require electric charging infrastructure. However, RAM will likely also include hydrogen-fueled aircraft, as well as hybrid aircraft, some of which can leverage existing ground infrastructure. Taken together, these factors could enable RAM to gain traction sooner than UAM.

The RAM market is already taking shape. More than 50 companies are developing battery-electric, hybrid, and hydrogen powertrains; new and retrofitted aircraft designs; advanced avionics; operations and booking platforms; and other important enablers of the RAM ecosystem. More than \$1 billion has been invested in these RAM start-ups to date and the first retrofitted aircraft are slated

to enter service in the mid-2020s. Simultaneously, an ecosystem of operators, consisting mainly of established airlines and regionally focused start-ups, is coming together to drive the industry forward.

A departure from recent trends in regional travel

The potential growth of RAM represents a departure from historical declines in the market for regional flights on small aircraft. Although air travel for trips between 150 and 800 kilometers has increased in recent years, with ASKs rising by 55 percent from 2004 to 2019, much of this growth was driven by low-cost carriers using larger aircraft. For aircraft with six to 50 seats, ASKs declined by almost 60 percent in the same timeframe.⁴ In 2019, passenger revenues for air trips between 150 and 800 kilometers were almost \$50 billion, but only 11 percent (or \$5 billion) came from flights on aircraft with six to 50 seats, including non-scheduled flights and business jets.⁵ Airlines have gradually shifted toward bigger aircraft and have consolidated operations at larger airports. A shortage of pilots has also contributed to the phaseout of small regional aircraft from airline operations.

In tandem with the decline in regional traffic, production of small aircraft has slowed, with the exception of private aircraft. Deliveries of passenger aircraft with six to 50 seats (for commercial, non-scheduled, and business or private use) peaked at about 1,500 in 2008. While the global fleet of six- to 50-seat passenger aircraft grew from 21,500 aircraft in 1990 to 41,400 in 2022, the growth was exclusively driven by business or private aircraft. Excluding business or private aircraft, the fleet has declined from 6,100 aircraft in 2008 to 4,100 today. New deliveries averaged 1,000 aircraft per year from 2016 through 2022, of which 98 percent were business or private aircraft.⁶ The decline in production, combined with the increasing age of the small regional fleet, may compel regional operators to invest in green

⁴ Cirium Diio Mi database, March 20, 2023.

⁵ FlightRadar24 database, March 20, 2023; MarketS database, March 20, 2023.

⁶ Cirium fleets analyzer database, March 20, 2023; includes commercial regional jets and turboprops, non-scheduled aircraft, and business or private aircraft.

propulsion aircraft rather than extending the life of existing aircraft.

Policy and local community factors have also negatively affected legacy regional air travel. In Europe, the number of Public Service Obligation routes declined from 290 in 2013 to 176 today. Similarly, US government Essential Air Service subsidies cover 175 airports today, down from 400 in 1980.⁸ In addition, concerns about noise and emissions have stymied some attempts to increase flights at regional airports.⁹ Quieter, more environmentally and community friendly RAM aircraft could begin to reverse these headwinds.

Although the regional market has declined, key infrastructure remains. There are thousands of regional airports worldwide, most of them underutilized. In Europe, 50 percent of people live within a 30-minute drive of a regional airport, compared with 40 percent for a commercial airport. In the United States, 90 percent of people live within a 30-minute drive of a regional airport, compared with 60 percent for a commercial airport.¹⁰ This existing capacity of underutilized airports could support a growing RAM market with less investment and ramp-up time than other new modes of transport.

Four megatrends and rising investment

While the regional air travel market has been in decline over the last 30 years, it could be taking off again, thanks to four global megatrends:

1. *Technological advances.* Innovations in propulsion and aircraft design and manufacturing, combined with next-generation guidance, navigation, and control, could

drive down operating costs and make small aircraft more competitive.¹¹ In the longer term, technological advances may even enable autonomous aircraft, which would further lower costs, as labor typically accounts for 20 to 30 percent of small aircraft operating costs. Some OEMs are developing novel propulsion powertrains that can be retrofitted into existing aircraft, a more straightforward path to market. Beyond aircraft improvements, innovations such as modern flight planning and navigation systems, cloud services, digital tools for fleet and network planning, and predictive maintenance are also enabling smoother and lower-cost operations. For example, the increasing use of precision GPS approaches, rather than traditional instrument landing systems (ILS), will allow smaller airports to receive reliable air service without the need for costly navigation infrastructure.¹²

2. *The importance of sustainability.* Governments and the public are increasingly focused on sustainability; their concerns will help shape the future of the aviation industry, which is responsible for approximately 4 percent of anthropogenic global warming.¹³ New initiatives and policy frameworks seek to lower the climate impact of aviation, including regulatory mandates for emissions reductions and sustainable fuel blending.¹⁴ These trends demonstrate an opportunity for growth in sustainable regional air travel. Almost half of travelers recently surveyed believe there are not enough sustainable options and 87 percent want to travel in a more sustainable way.¹⁵ One-third of travelers rank emissions as their number one aviation concern, ahead of others such as noise pollution and excess tourism, and over 25

⁷ "Public services obligation," Transport Themes, European Commission, September 2019; "Definition of public service obligations potential in new EU member states," Transport Problems, European Commission, March 2017.

⁸ Bella Richards, "What is the USA's essential air service program?" Simple Flying, September 11, 2022; Logan R. Leyer, *Evolution of essential air service program 1978–2012*, Southern Illinois University, Carbondale, August 2013.

⁹ Kevin Antliff et al., *Regional air mobility*, NASA, April 2021.

¹⁰ *Future mobility*, "Right in your backyard: Regional airports are an accessible and underused resource for future air mobility," blog entry by Leonardo Blanchik, Benedikt Kloss, and Robin Riedel, McKinsey, May 26, 2022.

¹¹ *Regional air mobility*, April 2021.

¹² Localizer performance with vertical guidance; Fred Simonds, "ILS on the block," IFR, January 29, 2020.

¹³ *Special report on aviation and global atmosphere*, IPCC; Liz Kimbrough, "How much does air travel warm the planet? New study gives figure," Mongabay, April 6, 2022.

¹⁴ "Fact sheet: EU and US policy approaches to advance SAF production," IATA, December 1, 2022.

¹⁵ *Sustainable travel report 2021*, Booking.com, June 2021; Sustainable travel study, Expedia Group, April 2022.

¹⁶ McKinsey research based on passenger survey, July 2021.

percent are willing to pay at least 5 percent more for carbon-neutral tickets.¹⁶

personal car ownership will likely increase interest in RAM.

3. *Road and airport congestion:* The priority for most travelers is to get from point A to B quickly and easily. But on the road, the typical driver in the United States loses 51 hours annually due to congestion; in the United Kingdom, drivers lose 80 hours annually. In 39 percent of US metro areas and 42 percent of European metro areas, traffic was worse in 2022 than it was before the COVID-19 pandemic.¹⁷ Major airports are once again congested, delays are common, and system meltdowns regularly make headlines.¹⁸ More than 190,000 flights were cancelled in the United States alone in 2022.¹⁹ Compounding the problem, large airports have little room to expand. More than 200 major airports worldwide—handling 43 percent of the world's passengers—are capacity constrained and routinely limit landing slots.²⁰ These factors, exacerbated by the consolidation of flights at major hubs, make for a frustrating and delay-prone travel experience. These trends underscore the unmet demand for a fast transportation mode that avoids congested roads and major airports.
4. *The rise of mobility as a service.* The past ten years have seen a rise in public appetite for mobility as a service, enabling people to search and book multiple types of transport in one place, reducing the need for individuals to own vehicles and allowing the sharing and thus better utilization of transportation assets. Consumer spending on shared ground mobility is forecast to grow to between \$500 billion and \$1 trillion by 2030. Over \$100 billion has been invested in shared ground mobility companies since 2010.²¹ Consumers have shown they are willing to try alternative forms of mobility if they offer good value, convenience, and accessibility through a user-friendly app. The growth of this ecosystem will allow RAM operators to streamline the first and last mile of transportation, reducing consumer pain points related to wait times and overall transit times. In addition, declining

Spurred on by these four megatrends, investment in RAM is rising. Since 2015, over \$1.1 billion in investment has been disclosed for this space, out of the over \$16 billion invested in future air mobility as a whole. This does not include R&D investments by incumbent aerospace firms that have not been publicly disclosed.

More than 50 companies are developing battery-electric, hybrid, or hydrogen aircraft, or powertrains for retrofit, with 2025 seen as the earliest potential date for entry into service. Companies that are developing powertrains include Ampaire, MagniX, Pratt & Whitney, Rolls-Royce Electric, VerdeGo, and ZeroAvia. Other players are working on new aircraft designs using those technologies, including Airbus, Electra.aero, Embraer, Eviation, and Heart Aerospace. Yet another set is working on highly augmented flight controls and autonomy, including Boeing, Merlin Labs, Reliable Robotics, Sikorsky, Thales, and Xwing. Operators that are actively engaged in this market include Air Canada, Air New Zealand, Surf Air Mobility, United Airlines, and Widerøe Zero. There are more than 4,700 RAM aircraft or powertrains on order, option, or subject to letters of intent, with a total value of \$38 billion.

A potential multi-billion-dollar market in the making

While the RAM market has momentum, estimates of its potential value vary widely. Our modeling suggests a TAM for RAM passenger revenue of \$75 billion to \$115 billion by 2035 (Exhibit 2).²² This includes \$40 billion to \$65 billion from travelers switching away from ground or marine travel, \$18 billion to \$20 billion from passengers who take RAM flights instead of commercial flights on larger aircraft, and \$12 billion to \$25 billion from stimulated demand—that is, travelers taking trips they would not otherwise have taken, due to the convenience and availability of RAM. Our estimate of TAM includes roughly \$5 billion in revenue for existing

¹⁷ "2022 Global traffic scorecard," INRIX, 2022.

¹⁸ Jon Brodtkin, "FAA outage that grounded flights blamed on old tech and damaged database file," Ars Technica, January 12, 2023.

¹⁹ US Bureau of Transportation statistics, 2022.

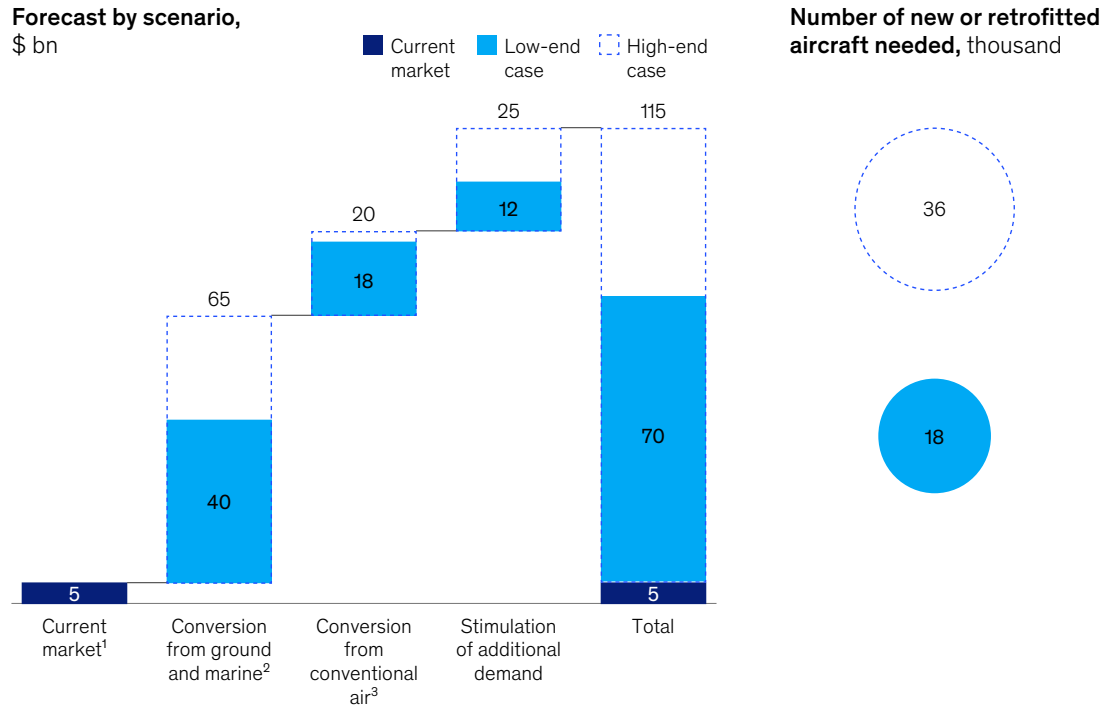
²⁰ Fact sheet: Worldwide airport slots," November 2022.

²¹ "Shared mobility: Sustainable cities, shared destinies," McKinsey, January 5, 2023.

²² Global passenger RAM market defined as flights for point-to-point trips of 150 to 800 kilometers operated by five- to 50-seat aircraft.

Exhibit 2

The total addressable market for passenger RAM could reach \$115 billion by 2035.



¹Includes commercial flight on 5–50 seat aircraft, business jets, and non-scheduled passenger flights.

²Includes car, bus, rail, and ferry.

³Commercial flights on aircraft with >50 passengers.

point-to-point flights 150 to 800 kilometers in length, operated by aircraft with five to 50 seats.

To estimate the TAM, we used anonymized cell phone location data, which show where people travel, in combination with estimates on aircraft operating costs, operational metrics, and route-level time savings calculations. Our model assumes that demand for travel will increase in line with historical growth and that travelers will switch to RAM from ground or marine travel, or from commercial air travel on larger aircraft, if the economics and time savings merit it.

Our model estimated global RAM market size and aircraft needs under two scenarios. The low-end scenario is based on a modest operating cost

reduction against current small aircraft economics, while the high-end scenario reflects a more significant operating cost reduction, driven by semi-autonomous operations. Both TAM scenarios are unconstrained—in other words, they assume that everything that is needed to enable the market will “go right” and that the industry can meet demand by producing the required aircraft and establishing needed airport infrastructure, which will not be a trivial task. As a point of comparison, the estimated 2035 TAM for RAM is 8 to 13 percent the size of the 2019 global commercial airline market.²³

For the RAM market to reach its full potential, we expect 18,000 new or retrofitted RAM aircraft will be required by 2035 in the low-end scenario and 36,000 in the high-end scenario.²⁴ Achieving

²³ “Fact sheet: Industry statistics,” December 2022.

²⁴ Estimate is based on a market size model and assumes that all new or retrofitted aircraft produced between 2025 and 2035 will be in service in 2035.

this level of production will require significant investment in OEM and supply chain capacity. More than 3,500 new or retrofitted RAM aircraft will need to be produced annually between 2025 and 2035 in the high-end scenario. This number is more than twice the approximately 1,500 regional or private aircraft built in 2008, the previous production peak.

What needs to happen for the RAM market to take off?

Many factors will influence the growth and ultimate size of the RAM market (Exhibit 3). Take trip distance—a passenger would see more time savings compared to driving for a flight that is 800 kilometers, rather than a 150-kilometer

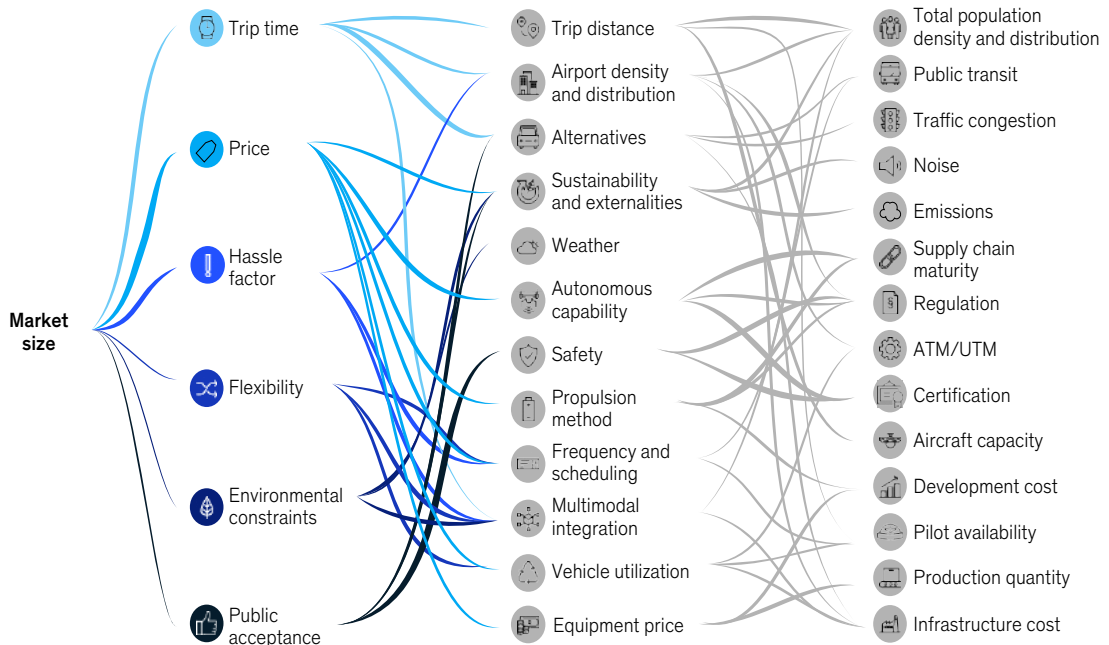
flight. Likewise, the population density of a given geographic area must be high enough to ensure a steady stream of passengers. Choices on aircraft capacity and scheduling also play a role, as do environmental constraints, the flexibility of RAM in meeting passengers' needs, and public acceptance. All of these categories depend on multiple variables. Public acceptance, for instance, will partly depend on guaranteeing RAM's safety.

At a macro level, four enablers will be particularly important for the RAM market's growth:

1. *A seamless end-to-end customer experience.*
In a recent McKinsey survey of potential RAM passengers, respondents stated that

Exhibit 3

Growth of the RAM market will depend on numerous inter-related factors.



time savings would be the primary reason for switching to RAM, followed by convenience and flexibility. Passengers who might forego their cars and take RAM flights will need transparent information on timing, a simple booking process, good access to airports, an efficient security and boarding process, frequent or on-demand flights, and first mile/last-mile integration. Avoiding the “hassle factor” is critical (Exhibit 4).







For instance, travelers may have to switch from RAM to another transportation mode, and some people might prefer to drive the entire trip to avoid such shifts. RAM operators could mitigate the hassle by coordinating flights with last-mile transport, so a car would be waiting when an aircraft lands, minimizing mode switching time and boosting predictability.

2. *Continuous technological advances.* Aviation has significant energy needs, but a battery, by weight, holds just one-fiftieth of the energy of an equivalent unit of jet fuel.²⁵ Battery energy density will need to at least double today’s density for the RAM market to meet its full potential. Similarly, hydrogen fuel cells are at an early stage of maturity and further advances will be critical to RAM’s growth.²⁶ Hybrid powertrains are nearer to commercialization and will play an important role. Improvements in composites, especially thermoplastics, will be needed to enable high-rate, low-cost production of lightweight airframes. OEMs are likely to employ advanced simulation and AI-enabled digital engineering to iterate and optimize designs quickly. All of these technologies must be extensively tested and certified for use in

Exhibit 4

While advanced air mobility can save customers time, leaders will need to solve several ‘hassle factors’ that favor journeys by car.

Illustrative comparison of 320-kilometer journey by car versus RAM

	Car	RAM
Trip time Moderate times savings of 1–2 hours with RAM		
Price Lower average cost per mile for car		
Schedule flexibility Can leave by car at any time		
Planning complexity Single mode reduces complexity for cars, although required to account for construction and traffic		
Reliability Lower system complexity for automotive drives fewer cancellations		
Predictability Higher risk of traffic and mid-trip delays in car		
Mode changes No mode changes when driving		

²⁵ “Sustainable aviation fuel,” US Department of Energy, May 2023; Terry Persun, “Advancing battery technology for modern innovators,” American Society of Mechanical Engineers, May 2021.

²⁶ *Target true zero: Delivering infrastructure for battery- and hydrogen-powered flight*, World Economic Forum, April 20, 2023.

aircraft—which, in some cases, may require regulators to develop or update certification standards and regulations. Beyond the aircraft themselves, new air traffic management systems will be required to govern the higher volume of small aircraft in crowded airspaces, including some that may eventually be autonomous.

3. *Increased public acceptance.* Passengers must be willing to fly on aircraft with new propulsion technology and ultimately on autonomous or semi-autonomous aircraft. Simultaneously, industry players may need to overcome local resistance to increased traffic at small airports, especially near urban areas. RAM aircraft have advantages here: Beyond reduced emissions, small electric aircraft create smaller noise footprints and have flight profiles that mitigate noise compared to conventional regional aircraft. Still, technical improvements alone will not sway hearts and minds. OEMs and other industry champions will need to engage with communities, collaborate with travel and local development groups, and respond appropriately to public concerns. Successful RAM players will be able to articulate the significant benefits to communities and travelers to overcome inherent skepticism of new technology.
4. *Airport and energy infrastructure to support the new fleet.* For the RAM market to truly take off, airports will require hydrogen and electric charging infrastructure. A typical regional

airport serving 200,000 passengers annually could require \$6 million in investment for charging or fueling. For electric aircraft, it would require 15 to 30 megawatts of peak onsite electrical power for charging. To fuel hydrogen planes, the typical airport will need 500 to 1,500 tons of hydrogen annually. The cost of green hydrogen fuel—which must be from low- or zero-emissions sources—will need to fall significantly for the economics to work. Additionally, hydrogen must be produced in sufficient volumes to serve the market globally. While RAM benefits from its ability to use existing airport infrastructure, energy infrastructure will require significant investment for the market to scale.²⁷

Overall, the trends suggest that RAM's time has come. The world may soon discover this revived form of air travel, which is more sustainable and capitalizes on underutilized infrastructure that we already have today. Re-energizing short-haul air travel will help increase equity for rural communities and stimulate economies beyond major metropolitan hubs. Material uncertainties remain about RAM's future, but a discernible path forward exists to support strategic decision making—and to create value in a market whose time has come.

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The authors would like to thank Andrea Cornell, Guenter Fuchs, Tore Johnston, Adam Mitchell, and Michael Saposnik for their contributions to this article.

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