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House Aviation Subcommittee Hearing: Airspace Integration of New Aircraft
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Introduction

Chairman LoBiondo, Ranking Member Larsen, and distinguished members of the Subcommittee, thank you for the opportunity to appear before you today on behalf of Joby Aviation to discuss electric air taxis, the promise of next-generation air mobility, and how these aircraft can be integrated into our nation's airspace.

For more than 10 years, Joby Aviation has been at the forefront of next-generation air vehicles built around economical and sustainable fully-electric powertrains. In pioneering efforts both with NASA and the US Department of Defense, we have helped push the boundaries of the possible in flight through the careful application of distributed electric motors and large-format lithium-ion batteries to air vehicle design. Distributed electric propulsion is the efficient use of a large number of smaller electric motors to distribute sources of thrust to create redundancy. This increases safety, improves aerodynamic efficiency for greater range and speed, and lowers the noise profile of air vehicles for greater community acceptance. One example of our early work is the X-57 Maxwell—the first all-electric "X-plane"—developed in conjunction with NASA and other private industry partners.

More recently, Joby Aviation has been 100% focused on the development of a piloted, five-seat, all-electric, vertical takeoff and landing passenger aircraft optimized for the delivery of on-demand air travel. Our design goals for the vehicle were threefold: first, unparalleled safety through layered redundancy across both the vehicle design and design of the subsystems therein; second, an extremely low noise profile via an all-electric powertrain and the careful design of our propellers; and third, highly-efficient operations to maximize passenger seat-miles per unit of time and drive to increasingly low cost with higher utilization.

We are a development-stage company venture-backed by prominent angel, institutional and strategic investors. Currently we are a team of 180 engineers and technicians and expect to continue to grow rapidly, creating thousands of jobs in engineering and manufacturing over the next 5 years. This job growth is in part fueled by our philosophy of vertical integration where we achieve tight integration, rapid development, and efficient production by designing and manufacturing the majority of our aircraft, systems, and components in house.

The Problem + Solution

The transportation systems in many of our nation's cities are at a breaking point. Over the past 20 years, we have seen increasing numbers of people moving into and around large metropolitan areas. Existing ground infrastructure—whether bridges, roads, tunnels or mass transit—is struggling to serve this increasingly concentrated population. It is still not easy, cheap nor fast to build new ground infrastructure to match increased demand. The result in

many cities throughout the US is longer commute times, wasted productivity with an increasing percentage of people's days in cars, and a lower quality of life for many of your constituents.

We designed our aircraft to help solve this problem.

Our aircraft will have a professional pilot onboard and will transport four passengers to their destinations more than five times faster than existing ground transportation at greater safety and, in time, at equivalent cost without the need for extensive, new, fixed ground infrastructure. Our vehicles can take off and land from almost anywhere—including rooftops, parking structures and existing heliports. They are more than one hundred times quieter than current helicopters, meaning they can get people closer to their final destinations without disturbing surrounding communities. They are significantly more cost-effective, due to lower energy costs and simplified maintenance. At increasing utilization, we can drive to a cost per passenger-mile that is on par with the costs of ground transportation today. We aim to make this a mode of transportation that is affordable and accessible to everyone.

When deployed as an on-demand fleet with high-volume and high-frequency operations, we believe these vehicles can have a significant positive impact on lowering commute times, increasing productivity and quality of life, and reducing carbon emissions in and around prominent cities such as Los Angeles, Dallas, Philadelphia and Washington D.C.

However, we also believe that the transportation problem we can address is not limited to cities. Today's hearing is on "Urban Air Mobility", but we believe the problem and our solution is not just for large metropolitan areas. We aim to deliver fast, efficient and cost-effective air travel to suburban and rural communities too.

Traditional car-based ride-sharing networks like Uber or Lyft that rely on ground vehicles require significant population density to work. Their low prices are predicated on a high volume of passengers in a small area and a high number of drivers in a geography to service them. Only with those two ingredients can they drive value—whether that's low prices or prompt service.

That is not the case for aircraft like ours. Because our aircraft can travel point-to-point at high speeds, we can deliver highly-utilized cost-effective service for more sparsely populated rural and suburban communities as well.

Many companies here are rightly focused on large metropolitan areas where existing transportation networks are overwhelmed. However, rural and suburban communities often face a different problem—namely, limited or non-existent transportation infrastructure. Our vehicles and our service can help people in these places as well: expanding economic opportunity by opening up new job markets, increasing quality of life with better access to health and human services, and strengthening personal relationships with far-flung friends, family and colleagues.

Challenges + Opportunities

If I could leave you with one takeaway from today's hearing, it would be that this technology is very real, very possible, and it is here now. We are optimistic about the promise of Joby Aviation in part because our FAA partners—who have for 60 years managed the safest transportation system in the world—are progressive and forward-thinking about the future of air travel. They share and continue to support our mission and timeline. Congress has and should continue to support these efforts by ensuring that the FAA has the resources it needs to support the development and integration of this technology.

America is a recognized leader in aerospace technology—a sector that delivers $143 billion in export sales and supports more than 700,000 high-paying jobs across the country. It is imperative that the US maintains its position as a leader in the development of the next-generation of air vehicles.

There are three areas that are worth discussing in greater detail here: airspace, regulation and infrastructure.

Airspace

Managing airspace will be one of the key challenges for us and others in delivering safe, efficient and reliable air-transportation-as-a-service to end consumers. Unlike other companies, we made an early decision to design our vehicle and begin our operations wholly within the existing airspace management framework. We will have a pilot onboard from day one who can coordinate and deconflict our flights using the traditional, radio-based system to maintain real-time communication with FAA flight control staff. Our initial operations will be very much like helicopter operations today—coordinated along current flight paths and following established and provably-safe methods of operation.

However, as the size of our operations scale—whether the volume of vehicles in continuous operation in and around a given geography or the frequency of those operations—we will need to move to an increasingly automated air traffic control system that allows for the digital deconfliction of airspace in real-time with limited input from either our pilots in the air or FAA staff on the ground. Some of this work has already begun with the ongoing development of the Unmanned Aircraft System Traffic Management (UTM) system led by NASA and the FAA.

We support the ongoing work to develop and implement a UTM system for drones operating in uncontrolled airspace at low altitudes and appreciate Congress's continued support for these efforts. We also believe that UTM should be scalable for operations of larger passenger-carrying vehicles at higher altitudes. Today, airspace integration efforts should focus on the communication between users who transition from a UTM to ATC—uncontrolled to controlled airspace—and vice versa. We support NASA's work on both UTM and urban air mobility and ask the Committee to encourage the FAA to make this NASA-FAA partnership a priority.

Regulation

The path to certify for vehicles like ours has already been dramatically improved by the FAA's adoption of Amendment 64 of the Part 23 Airworthiness Standards. We believe Part 23 plus special conditions can provide a reasonable basis for our vehicle certification. With Amendment 64, many of the overly-prescriptive means of compliance were migrated toward consensus-based industry standards that preserve the safety objectives embedded within the Part 23 requirements while also allowing for novel means-of-compliance to meet these goals. We firmly believe that this approach allows for a more adaptive framework to define and accept new means-of-compliance associated with novel underlying technologies and vehicle configurations.

At Joby, we have already been working closely with FAA for more than eighteen months to help adapt these new Part 23 and related guidelines to the certification of our aircraft. We encourage Congress to continue to support this important work. As in many areas of governance that have come before your committee—like the development of autonomous ground vehicles—we believe the most expedient way to safely introduce new technology is through private and public partnership around clear, shared goals.

Infrastructure

Alongside the airspace management and vehicle certification, landing sites within urban, suburban, and rural airspaces are a necessary component of the successful delivery of this service. The provisioning of these locations requires careful consideration of updated standards related to landing zone requirements as well as site security and passenger security. Different locations will have some unique needs due the local zoning, population density and physical geography.

Despite the differences in geographies, however, it is important that standards for these sites are more uniform rather than less so—both within the US and, ideally, internationally. To that end, it is important that Federal preemption for the FAA in the area of aviation is respected both legislatively and judicially. A patchwork of disparate, regionalized regulation is not in the public interest.

We have already begun working with select municipalities to help define standards and best practices for takeoff and landing sites and for operations. We encourage close coordination and cooperation between the Federal, State, and Local governments and regulatory agencies to synthesize these best practices in formal standards that can provide a clear, nationwide path to compliance and authorization.

Furthermore, the FAA, EASA, and other regulators should work together to develop globally-coordinated safety system expectations through agreed upon consensus standards that ensure the viability of reciprocal airworthiness acceptance. The relatively recent General Aviation Manufacturers Association Electric Propulsion Innovation Committee (GAMA EPIC) has

brought both American and European voices into the conversation together. We encourage both agencies to continue to seek opportunities for collaboration and joint rulemaking.

Closing

Joby Aviation is committed to delivering on a new mode of on-demand air transportation that offers unprecedented freedom to get from one place to another for your constituencies—whether in cities, suburbs, or rural areas.

We are on the cusp of an exciting development for consumers, travelers, technology and America's global leadership in aviation. It's not hyperbole to suggest that the introduction of our aircraft and other electric vertical takeoff and landing (eVTOL) aircraft like it have the opportunity to transform the way people travel, where they live, and how they spend their time. It's a transportation revolution on par with the introduction of the railroad, the car, and jet travel. Just as each of these transportation modes had incredible, positive impacts on economic opportunity and quality of life, so too can on-demand air-travel with eVTOL usher in a new set of gains.

I thank this committee for this timely hearing and want to emphasize that the next generation of transportation and technology at Joby Aviation is closer than you might think. With Congress' support, we can begin to improve mobility, safety, and quality of life in the very near future. I look forward to your questions.