Roei Ganzarski
CEO, magniX
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Good morning Chairman Larsen, Ranking Member Graves, and esteemed members of the Aviation Subcommittee. My name is Roei Ganzarski and I am the CEO of magniX. magniX, headquartered in Everett, WA, designs and manufactures all-electric propulsion systems for commercially focused aircraft. I am also the executive chairman of Eviation. Headquartered in Arlington, WA, Eviation designs and manufactures electric aircraft starting with the Alice, a 9-passenger all electric commuter aircraft. Thank you for giving me the opportunity to provide my insights on the future of aviation in the United States.

Before I begin, I wanted to express what a personal honor this is for me to be testifying here in front of you. I came to this country 24 years ago from Israel, in pursuit of a graduate education at the University of Washington. In addition to a great education, I found a home; a haven to start a family and raise three amazing children; and a flourishing environment to expand my career, grow companies, and create jobs. The American Dream is alive and well. I thank you for that.

Accessible, affordable, equitable, environmentally cleaner, and quieter - this is the future of aviation we should be striving for in the United States. An aviation system that offers and promotes the ability to travel, send and receive packages, and commute in a low-cost, sustainable,

quick, and convenient door-to-door fashion. This is the future of aviation that I, and the entire team at magniX and Eviation, are working towards.

In this future aviation system, the average American, including in more rural areas, should be able to drive no more than 15 minutes to their nearest airport (most likely not a large metropolitan hub airport), arrive there only 15 minutes ahead of their flight, walk onboard without hassles or waiting in lines since the airport is smaller, fly for up to a few hours, land, and arrive at their destination in another 15 minutes, because their smaller arrival airport (most likely not a large metropolitan hub airport) is closer to their final destination. While this may sound like an unrealistic utopia, for the most part, the technology and infrastructure to provide such an aerospace environment is being developed, flight-proven, and on the path to FAA certification today.
It is called the "Electric Age of Aviation."
It will happen. The question is: will the Unites Stated lead or lag?

On the world stage, the United States has always been a leader. Whether it is economics, culture, or technology, the world looked to the US to see and understand the future. In aviation, the United States will always be remembered and respected for that magical Wright Brothers' first powered flight in Kitty Hawk, North Carolina.

However, I am afraid our country is now falling short. We are falling short of our reputation for pioneering innovation; falling short of our track record in leading an industry; and in particular, falling short for not embracing two major cultural shifts that are happening both globally and domestically: a shift to democratize demand-driven aviation in a way that makes it available and accessible to all, and a shift to propel clean energy in aviation.

Sweden and Norway are increasing their commitments to curb emissions by pledging that all domestic flights will be electric – in other words, emission-free - by 2030 and 2040, respectively. France is right now passing legislation that will ban short-haul flights as long as they produce emissions. The United Kingdom is directly providing its aviation industry with hundreds of millions of dollars to advance carbon-free technology. In fact, the UK is attracting U.S. companies to move across the pond.

As the home of the Wright brothers, Benjamin Franklin, Thomas Edison, and Apollo 11, our legacy as leaders, inventors, innovators, and a country that asks "why not" demands ambitious, aspirational, and forward-thinking policies to spur immediate and bold action, and encourage behavioral change on a grand scale. We must use the power of pro-active government policy and incentives to help propel progress.

Some positive movement has recently started. Congressman Graves (Louisiana) and Representative Davids (Kansas) introduced the Advanced Air Mobility Coordination and Leadership Act. The legislation focuses on development of new transportation options, moving goods, amplifying economic activity and jobs, advancing environmental sustainability and new technologies, and supporting emergency preparedness and competitiveness.

Reps. Larsen (Washington), Schrier (Washington), and Davids (Kansas) introduced the National Evaluation of Aviation and Aerospace Solutions to Climate Change Act, instructing the U.S. Department of Transportation to partner with the National Academies of Sciences, Engineering and Medicine to study, catalogue and report on technologies, processes, materials or practices that contribute to the reduction of greenhouse gas emissions.

With that said, much more must happen. The United States must act in unity and continue to move rapidly, aggressively, intentionally and with focus, if we want to lead this global electric aviation revolution that is happening.

This global electric aviation revolution, promises significantly lower costs of aircraft operations, significantly reduced noise pollution, and zero carbon (CO2) emissions. The hourly operating costs of all-electric aircraft are 40 to 80 percent lower than using traditional fuel-based technologies. These savings stem from two main elements. The first is the much cheaper price of electricity when compared to fuel. For example, a ninety-minute flight on a nine-passenger fossil-fuel powered aircraft will burn about $424 in fuel. The all-electric version of the same aircraft will only use $24 in electricity. The second reason for the lower operating costs is maintenance. Current engine technology is very complex, requires many parts working in unison turning at thousands and tens of thousands of revolutions per minute, at very high temperatures under substantial friction. This requires significant, regular, time consuming, and expensive maintenance. An electric propulsion system only has one moving part, turning at very low revolutions per minute, and operating at relatively low temperatures. The simplicity of electric propulsion means dramatically reduced maintenance costs.

Transitioning to all-electric aviation means airline operators gain efficiency, can better respond to increasing demand with smaller aircraft flying from and to smaller airports, and offer more affordable pricing for travelers and cargo alike. And this transition means lower noise and zero emissions. Moreover, with the country's electric grid becoming cleaner and more renewable every year, we are on a clear pathway for an entirely clean electric value chain.

By incentivizing the move of the aviation industry to electric flight by using small to mid-sized aircraft, we will be creating affordable access to and from more rural areas and we can better connect all of America. We can fulfill the vision this country had for the aviation industry in the 1930s, '40s, and as late as the '60s, when the massive number of small regional airports we have today in this country were built.

Doing this will require us all to be bold. I would like to take you back to a time our country and our leadership had the intestinal fortitude to make courageous investments, take decisive action, and lead the world. On September 12, 1962 President John F. Kennedy told an audience at Rice University:

"…So it is not surprising that some would have us stay where we are a little longer to rest, to wait…but this country of the United States was not built by those who waited and rested and wished to look behind them. This country was conquered by those who moved forward…

We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win, and the others, too. It is for these reasons that I regard the decision last year to shift our efforts in space from low to high gear as among the most important decisions that will be made during my incumbency in the office of the Presidency… To be sure, we are behind, and will be behind for some time in manned flight. But we do not intend to stay behind, and in this decade, we shall make up and move ahead."

Like conquering space and the moon, commercial electric aviation is an audacious goal. A goal that will require determination, focus, and grit. A goal that will compel us to put our best minds to

work and make sacrifices as we make advances. A goal that will require the US government to make changes in our policies, regulations, and funding.

We have all the ingredients we need right here in the United States to lead us on this tough journey. Companies like magniX and Eviation are doing this work right now. We have been designing, building, and flight testing the required technologies and solutions, and as companies, we are currently in a global pole position to lead the industry. In 2019, magniX retrofitted and flew the first-ever all-electric commercially-focused aircraft – a five-passenger de Havilland Beaver (eBeaver) in partnership with Harbour Air - that took flight on December 10, 2019 in Vancouver, BC. It has been flying ever since, collecting data, testing performance, measuring noise, and more.

A few months after the eBeaver's flight, in Moses Lake, WA, magniX started flying the world's largest all-electric commercially-focused plane – the magnified 9-12 passenger Cessna 208B Grand Caravan, now known as the eCaravan. With this aircraft flying at 8,000 feet, new heights were literally and figuratively achieved in terms of electric aircraft power and performance.

Both of our aircraft flew without creating emissions. That is right - not one ounce of CO_2 was emitted from these flights. Later this year, the nine passenger, all-electric Eviation Alice, the first aircraft to be designed from the ground up as an electric commuter, will be taking flight for the first time in Arlington, WA. This will be a monumental watershed moment for our industry. aNd it too, will fly without emissions.

Our all-electric flight test aircraft measured that electric aircraft noise energies are 100 times lower than those of traditional fossil-fuel-based engines. In practical terms, when one of these aircraft is

taking off 300 feet away from you, it sounds like people having a regular conversation next to you versus what it is today – noise levels of a vacuum cleaner operating next to your ears.

This topic is not, well, simply noise. Noise pollution is an important yet often sidelined pollutant from aircraft. The Harvard School of Public Health and Boston University School of Public Health found that people exposed to aircraft noise may face increased risk of being hospitalized for cardiovascular disease. And the number one cause of death in the US is heart disease. At significantly reduced noise levels, all-electric aircraft will also have far reaching impacts to our society and health.

The Environmental Protection Agency reports that aircraft contribute 12 percent of U.S. transportation emissions and account for three percent of the nation's total greenhouse gas production. In the United States alone, 45,000 flights carrying three million airline passengers take off every single day. If we continue down this path, by 2050, commercial aircraft emissions could triple, given the projected growth of passenger air travel and freight. This is not sustainable. Rapidly introducing electric aircraft that produce zero carbon emissions is absolutely essential to a clean-energy and healthy future.

In addition to flying electric aircraft to prove out the technology and its benefits, magniX has also been working closely with the Federal Aviation Administration (FAA) on certification. The FAA has already published the Special Conditions by which it will evaluate magniX's electric propulsion and magniX is on a path to FAA certification before the end of 2022.

Based on my experience, I believe the FAA is doing a great job and is working with the right attitude and approach. The agency is making every effort to learn about the new technologies and

their benefits, while maintaining the utmost integrity when it comes to safety, reliability, and quality. As I plan to have my own children and, eventually, grandchildren fly on these new aircraft, I appreciate the work the FAA are doing and expect them to continue to uphold the utmost safety and reliability standards.

With that being said, I think the FAA lacks the resources it needs for the enormity of the task ahead. They do not have enough staff to adequately support the new entrants and new technologies being introduced at a lightning pace. The resource shortage at the FAA is already creating delays; I fear that it will only get worse. I highly recommend that additional funding be provided to the FAA so that it can hire and train experienced staff and support the timely entry of new companies and technologies into the marketplace. This will also position the FAA to be the most knowledgeable and experienced regulator on this new technology, and enable them to teach and lead other regulatory agencies worldwide.

With electric propulsion certification on track for 2022, that means there is a real possibility for smaller all-electric aircraft to start flying people and packages on short routes within the next four years - within this current Administration's first term. This is an audacious – but realistic - goal for our industry.

The feasibility and benefits of electric aviation are clear and proven. I know the naysayers, many of them within the ranks of the incumbents of the industry's current antiquated technology, will provide many reasons why electric aviation is not feasible, why risks are not worth taking, why more time should be spent researching, analyzing, and debating, while the world moves ahead. Most of those reasons stick to a familiar theme: energy density of batteries and/or hydrogen fuel cells. Indeed, as I testify before you today, batteries and fuel cells are not powerful enough for a

large-scale aircraft, also known in industry as a single isle or twin isle aircraft, carrying 100 people or more, to fly 2,327 miles non-stop from Seattle to Washington D.C. Batteries are only good enough today, in 2021, to power a passenger aircraft carrying five to nine passengers up to 500 miles.

However, the question we should be asking is not "can an electric aircraft fly as far as a fossil-fuel based aircraft?" Instead, we should ask "does today's electric aircraft meet the demands of the flying public?"

In the United States, half of all airline flights are less than 500 miles. This speaks loudly to the need and opportunity for middle-mile regional electric flight. Moreover, only 1.6 percent of all 50 – 500 mile-trips in the United States are made by air. Travel for these distances is clearly in high demand, but the aviation industry has yet to provide customers a viable, affordable, and widely accessible option.

What's more, access and equity are real issues for the future of aviation. Electric aviation, with lower-cost flights at ranges of up to 500 miles, will enable affordable access even in the most rural of areas in the United States. Electric aviation will connect our communities like never before.

On the topic of energy sources, I would like to point out that electric aircraft can be powered by multiple sources of electricity. As long as the propulsion system, i.e., the technology creating the thrust, is electric, it is deemed an electric aircraft. The source of energy can be batteries, including lithium-ion, lithium-sulfur, lithium-metal, solid state, and other battery technologies currently being developed. The source of energy can also be hydrogen fuel-cells. These fuel cells create electricity that then flows to the electric propulsion systems. In the future, there might also be new

sources of electricity, fully renewable and recyclable, that are developed to provide the electrons needed.

Today, given the state of development, the majority of electric aircraft are battery-electric and specifically using lithium-ion batteries. I believe this is temporary, as better and better battery chemistries are being proven, as well as advances in the development of hydrogen fuel-cells.

While the source of energy is indeed the biggest challenge for mass adoption of electric aviation, I parallel this to where electric cars were less than ten years ago. When Tesla, the company that we attribute the democratization of electric cars started, it was with an electric propulsion system developed for cars, rudimentary batteries, and the conversion of the Lotus car. Mainstream car manufacturers, as well as battery manufacturers, discounted and disregarded Tesla and their idea of electric cars. The claims were similar to what we in aviation are hearing today – batteries are not good enough and there will not be enough range. But once Tesla started to prove that its converted cars where real, battery technology started to progress, and Tesla began to develop cars that were designed to be electric. Once it became clear this solution was real, other car manufacturers followed suit.

Today, in 2021, seeing an electric car drive on our streets is no longer a novelty, and seeing a car charger at the entrance to a shopping mall is no longer an anomaly. Tesla had to start somewhere to lead the electric car revolution. Similarly, that focus, intentionality, and patience is required in aviation. magniX started with propulsion and retrofits. Now companies like Eviation are designing aircraft to be electric. And battery companies and fuel-cell developers are starting to realize that the potential is real and are making investments to improve the sources of energy.

However, many of these companies are outside of the United States. Be it China, France, Germany, Norway, or the United Kingdom, these countries have created ecosystems that stimulate, incentivize, and financially support the rapid and aggressive development of carbon-free aviation. If the United States chooses to lead the electric aviation future, we'll see a significant number of jobs created across the nation. From advanced research jobs to aircraft assembly jobs to electronics manufacturing jobs - these jobs can support diverse workforces across the country.

A paradigm shift in our mindsets must occur for this to happen. We did not reach the moon in one attempt or one stage. The journey to the moon started with low-altitude rockets, then higher altitude ones, then low orbit, then high orbit, until eventually we could fly to and land on the moon. Expecting electric aviation to immediately be able to power a 737 sized aircraft as it flies across the country is not reasonable. In fact, it only deters and defers the inevitable. The American people want a low-cost, accessible, equitable, sustainable, quiet, and demand-driven aviation transportation system. Electric aircraft can enable that. We must start with the correct vision - with smaller aircraft flying shorter distances from and to smaller airports. And as investments are made, policies are set, incentives introduced, and technology progresses, we will be able to advance to larger aircraft flying longer distances – a pattern that should be familiar across most evolving industries.

To reach this audacious goal within the next four years, we need our President and Congress to take bold action to support and incentivize the move to electric aircraft and to provide the boost needed for the technology to really take flight. I recommend a holistic flight ecosystem approach: set aspirational goals, provide incentives, and set bold policies.

Aspirational Goals. In 1961, President John F. Kennedy announced before a special joint session of Congress the dramatic and ambitious goal of sending an American safely to the Moon before the end of the decade. This goal was achieved on July 20, 1969. With the current state of technology, our President and Congress could set a dramatic and ambitious goal of having all-electric aircraft start carrying passengers and packages for up to 250 miles in range by the end of 2024 and up to 1,000 miles by 2030.

Incentives. Congress needs to provide incentives for airlines and operators to adopt electric aircraft and use them on existing or new routes. In many ways, this would follow the same pattern as electric cars. When buying or leasing an electric car, the buyer gets a significant income tax credit against the car, sales tax exemptions on the purchase or lease, and more.

Following the same analogy, Congress needs to provide incentives for airports investing in charging capabilities and sourcing renewable energy from solar, wind, and hydro – just as installing an electric car charger at home provides a financial grant for the installation, incentivizing people to do so and eliminating a barrier in purchasing an electric car.

Finally, Congress needs to provide incentives for manufacturers developing electric propulsion systems for commercially focused aircraft, retrofitting conventional aircraft to electric, and designing and building new fully electric aircraft. Using an existing model familiar to automobile manufacturers, aviation carbon credits should be introduced in which manufacturers of fossil fuel-based aviation technology would be required to offset their environmental impact by buying carbon credits from all-electric aviation manufacturers.

These incentives can take the shape of budget allocations, financial grants, tax credits, rebates, exemptions, reduced registration fees, reduced utility rates, and other innovative proposals. We should also consider changes to the Essential Air Service - a taxpayer-funded program that subsidizes rural air connections. By simply adding an environmental-performance criterion to qualify for and be awarded such subsidies, operators will be encouraged to increase service to these underserved areas by using aircraft with lower operational costs and zero emissions. This will result in gaining additional clean and quieter routes without any increase in federal investment.

Set Bold Policies. Policies drive behavior and right now our behavior is lacking. Congress should set bold policies that require a certain percentage of domestic middle-mile flights be emission-free by a certain date. It could also require government officials fly a certain percent of their flights on zero-emission aircraft by a certain date. Similarly, the Department of Defense could operate short transport flights using emission-free technology by a certain date. Policies like this will set a clear line in the sand and send a message that this Administration and Congress – and the country, take this issue with the seriousness it deserves.

As this new electric aviation industry grows and flourishes, there is a significant opportunity to bring new jobs and training across the United States while meeting the goal of creating a more sustainable economy. Investing in electric aviation will create thousands of jobs, from manufacturers to suppliers to operators to airports and peripheral servicing companies, right here in the United States. Moreover, it will enhance the economies of smaller and rural towns by connecting them with low-cost and cleaner flights, enabling access to new markets.

It is my sincere hope that Congress provides all modes of transportation, and specifically electric aviation, the critical support needed to accelerate our country and provide good-paying jobs. Electric aviation will reduce our reliance on fossil-fuels, lower our carbon footprint, decrease aircraft operating costs, and create greater accessibility and connectivity to all areas in our country.

I will conclude by shamelessly paraphrasing President Kennedy, because his words are as relevant and accurate today for electric aviation, as they were for the Space Race in 1962:

We choose to transition to electric aviation within the next four years, not because it is easy, but because it is hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win. And while it is not surprising that some would have us stay where we are a little longer to rest - to wait - this country of the United States was not built by those who waited and rested and wished to look behind them. It was conquered by those who moved forward. I truly hope that as a country, we make the decision to shift our efforts in aviation towards electric. To be sure, we are behind, and will be behind for some time. But we do not intend to stay behind, and in the next four years, we shall make up and move ahead.

Thank you for giving me the opportunity to provide my insights. magniX and Eviation are proud to be a part of the solution that returns the American aviation industry to preeminence and global leadership. We can do this by continuing to build upon the innovative, environmentally sustainable technology that is already here and can soon be commercially available. With the right investment and incentives, electric aviation can and will be our reality starting within four years. We are on the cusp of the “Electric Age of Aviation;” the United States must take advantage of it.

Photos

Some of the magniX team members in the Everett, WA facility

magniX includes 23% women and 27% minorities

Photo taken in 2021

The eBeaver powered by magniX all-electric propulsion flying in Vancouver, BC

Photo taken in 2021

The eCaravan powered by magniX all-electric propulsion flying in Moses Lake, WA

Photo taken in 2020

The magniX facility in Everett, WA

Photo taken in 2020

The magniX logo