THINK BIG, DREAM GREEN

By Association member James Caulkins, photos by kind permission of LTA Research

How an airship company plans to repeat the electric car's success…

A new type of vehicle arose in the early 20th century, sparking public fascination with modern, glamorous travel. This vehicle's brief heyday as a novelty for the rich ended when a newer, faster competitor emerged. The world moved on, despite countless attempts to bring the obsolete vehicle back. For a century, skeptics judged them to be inherently impractical. That vehicle was the electric car.

We know how that story ends. Worldwide electric car sales have skyrocketed, going from 1% market share in 2016 to 14% in 2022. The electric car was revived using an engineering method known as 'first principles' thinking. This approach disregards conventional wisdom and popular opinions on what is possible and, instead, reduces problems down to their most fundamental, physical realities and reasons up from there.

Enter **LTA Research**, the brainchild of CEO Alan Weston, former project director of the NASA Ames Research Center. LTA is a new entrant in the race to electrify aircraft. Their aim is to simultaneously advance disaster relief missions and electric aviation. The company's **Pathfinder 1** has begun indoor test flights in Mountain View, California while the larger **Pathfinder 3** will follow shortly thereafter in Akron, Ohio.

But LTA's Pathfinders have one big difference from other electric aircraft: they're airships.

"Airship? What, you mean like a blimp?"

'Airship' is an umbrella term for any powered aircraft that uses buoyancy for lift. This includes Zeppelins with a rigid skeleton, inflatable blimps, and dirigible balloons. While mostly used for advertising and tourism today, their use was more diverse during the early 20th century. They were patrol ships, cargo transports, heavy bombers, aircraft carriers, rescue craft and luxury liners.

Past airships mostly used flammable hydrogen for lift. Engineers knew about that downside, but airships possessed other capabilities that airplanes lacked. Zeppelins had over four times the useful lift and eleven times the range of the largest airplanes of the time, and were only about one-third slower. By the mid-1930s, airships could lift up to 112 tons, fly over 8,700 miles, provide over 6,000 square feet of deck space, and carry up to 207 people.

After decades of advancements, though, airplanes broke all but a few of these old records. Past airships still hold the distinction of being the largest and most spacious aircraft ever built. They also retain the longest manned and un-refuelled flight endurance. In all other respects, however, they have been surpassed.

The Electric Aircraft Problem

So, why is LTA building airships instead of planes or helicopters? After all, many unusual vehicles have failed to carve out a niche in transportation. Ekranoplans, hovercraft, and supersonic jets all got replaced by conventional vehicles and infrastructure.

LTA believes airships' unique traits can solve problems that no other aircraft can. Batteries' currently poor energy density imposes severe limits on the size, speed, and range of electric aircraft. Airships completely circumvent these limitations on scale. They use energy for propulsion, not for lift, making them extremely efficient.

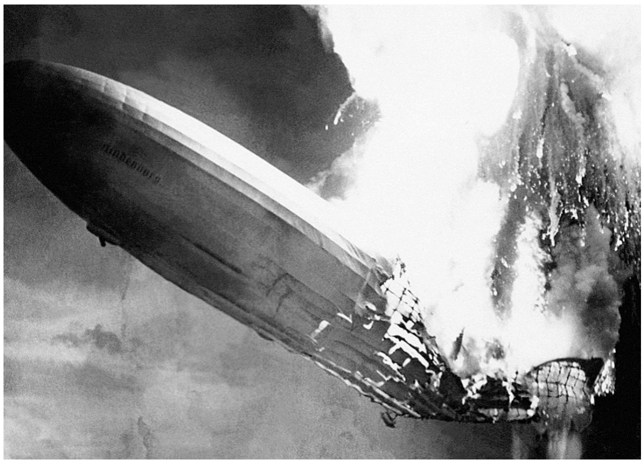
These characteristics translate to an overwhelming advantage in capability. Leading electric vertical-takeoff aircraft such as the **Archer Midnight** can only fly 100 miles and carry up to 1,000 pounds. By contrast, LTA's midsize **Pathfinder 3** can fly a staggering 10,000 miles and carry 40,000 pounds. The world's largest helicopter, the **Mi-26**, can only go 310 miles while carrying 17,000 pounds. LTA is even considering an airship that can carry in excess of 400,000 pounds of cargo. Unlike planes, airships can airlift supplies without being bottlenecked by distant or destroyed infrastructure.

Many useful cargoes are not weight-limited, but rather volume-limited. Not even specialty cargo planes can carry giant hospital modules, wind turbines, radio towers, or rockets. Only airships are large enough to transport these, and at half the cost per ton/mile. Even a midsize airship could accommodate an internal cargo bay longer than a football field. That's over twice the cargo space of the late **An-225 Mriya**, the largest airplane ever built.

These compelling benefits do raise the question - why have airships not returned already?

The Limits of Public Perception

Nowadays, airships are known for two things: the **Goodyear** blimp, and the **Hindenburg**. The latter was the subject of the first major disaster ever caught on film. 35 people died when the airship burst into flames as it approached its mooring mast at Lakehust, New Jersey on May 6th 1937 marking the first and last fatalities of Germany's Zeppelin Airlines. 62 people survived the disaster but history often overlooks them.



This poses a problem because people tend to latch onto the first example that comes to mind. Nuclear energy advocates can wearily attest to this phenomenon whenever someone brings up Chernobyl.

Public perception isn't always permanent or detrimental though. For example, cynics never imagined electric cars could be more than a glorified golf cart. In fairness, most startup attempts were exactly that. Nearly five hundred startups failed before the electric car was finally brought back. As soon as capable electric vehicles gained notoriety, the public latched onto the new example.

That's why the public's familiarity with the humble Goodyear blimp prevents people from taking airships seriously. Modern blimps only meet the minimum requirements necessary to be a floating billboard. They're just not impressive enough to budge public perception.

Imagine if the **Titanic** had been the last passenger ship, and a century later, it's the only ship anyone knows about. If you were starting a shipping company, how would you convince skeptical investors who have only ever seen inflatable boats? Ships would be a tough sell, regardless of potential improvements.

The Return of the 'Return of the Airship' Article.

The perennial **Return of the Airship!** article has been a staple of popular science magazines for a century. This one is from 2006. And for just as long, armchair engineers have loved tearing into these articles.

Granted, skepticism of futurism and vapor-ware is fully justified. Dead and dormant technologies attract tinkerers, crackpots, and nostalgics like flies, but the public and private institutions with the resources to actually build an airship are much more risk-averse. Like the failed electric car startups of the 20th century, generations of airship companies have gone bankrupt before even building a prototype.

"It'll never catch on" is an easy prediction to make, because it's true more often than not. Yet those are also the famous last words for many CEOs, companies, and even whole industries that were blindsided by paradigm shifts. But after so many false starts, how does one determine if and when dormant technologies are ready to return?

To answer that, one needs to go back to first principles. Why did airships go away in the first place? What issues prevented them from coming back? And do these new airships offer practical solutions? These questions need quantified, empirical examination, not just guesswork. After all, if a problem wasn't actually the cause of airships' decline, then solving it won't bring them back.

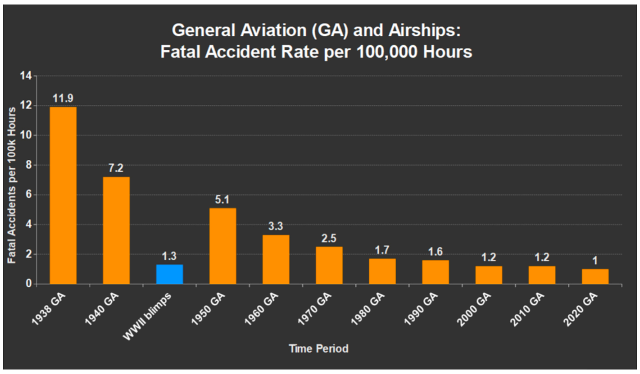
Airship Safety: Going by the Numbers

Hydrogen is a known danger, but some consider even helium airships too unsafe to be practical. Critics often cite anecdotal examples such as the U.S. Navy's **Shenandoah**, **Akron** and **Macon**, which were lost between 1925 and 1935 due to human error and fatal engineering mistakes. Regardless, they continued using airships until satellites and carrier-based helicopters replaced them in 1962.

World War II was the all-time peak of airship operation. The Americans entered World War II with only 10 airships, but would build a further 154 during the conflict. There's no better statistical sample for operating airships en masse, at length, and in difficult conditions.

Airships logged 555,500 hours of patrols and 280,000 hours of training flights on four continents during the war. Their unprecedented 87% mission readiness rate remains better than most military aircraft today. Airships from ZP-21 squadron patrolled 24 hours a day for an astounding 965 consecutive days. They defended 89,000 ships from submarines and mines, and despite thousands being sunk during the war, they only lost one. Airships' other major role was conducting search and rescue operations that saved hundreds of sailors and airmen.

In those years of hard use, there were 53 major accidents, resulting in the loss of 26 airships. 11 had fatalities, or 21%, similar to general aviation's 18% in 2019. Most blimps were categorised alongside civilian planes and helicopters as 'general aviation' aircraft before and/or after the war. The following chronology shows that the general aviation accident rate (in orange) decreases every decade, but wartime airships (in blue) are a clear outlier:



Of the blimps used in WWII, 97% were first flown between 1922 (J class) and 1938 (K class), but 1938 is the earliest year data exists to provide context for the 1930s. Sources: FAA, BTS

This counterintuitive record makes sense when one considers how speed affects crash prevention. Airships are essentially giant safety airbags. For perspective, the first year that U.S. general aviation was safer on average was 1999, and the last year it did worse was 2009. Even today, the best-selling helicopter in America has a worse fatal accident rate than blimps fighting in history's bloodiest war.

These numbers demonstrate that although crashes damaged airships' reputation, poor safety wasn't the root cause of their decline. Rather, their disastrous image stems from selective memory. Airships are huge, surreal, and captivating—so when one crashes, it's a spectacle that gets preserved for generations. By contrast, no one remembers that Pan Am lost nearly half of their iconic 'Clipper' seaplanes to accidents.

Can Airships Handle Storms?

Many attribute airships' decline to weather, thinking they need perfect conditions to fly. In reality, just like boats have varying seaworthiness, airships have varying airworthiness. The best way to predict their operability is to examine their real-world performance.

During the Cold War, the Navy's airships were used for radar detection and conducting scientific studies. One of these experiments, Project Lincoln, spent years deliberately flying airships into ice storms. They refined larger airships with sturdy landing gear that allowed for fast, heavy takeoffs with minimal ground crew. This vastly increased their control and operating limits.

In 1957, the **Snow Bird** embarked on a nonstop 11-day voyage to four continents that crossed the Atlantic twice. Her endurance record still stands to this day. In 1958, the **Snow Goose** (see edition 201 for full story) braved 40-knot winds and whiteouts to reach the T3 arctic base.

With two decks and up to 403 feet (122m) in length, the N-Class was the largest nonrigid airship. Its tricycle landing gear allowed it to take off several tons heavier than air, like an airplane rather than a released balloon.

All aircraft normally avoid bad weather, so the question is whether that hinders airship operations more than airplanes.

In 1960, **Operation Whole Gale** pitted airships against Lockheed WV-2 radar planes. These competitors were tasked with keeping continuous radar coverage for two months, including a 10-day period during the worst winter storms in 35 years. There were 60-knot winds and days of constant blizzards and icing. By the end of the operation, airships posted 1,647 hours on station to the airplanes' 150 hours. One ship rode out blizzards for four days straight without rest or resupply.

In the words of Commander Charles Mills, "Experienced pilots have demonstrated during hundreds of flights in thunderstorms that a properly designed airship can fly safely in this environment... Never in the two years that I ran the project did a ship drift or get blown off the runway, even with over 40 knots of wind."

Today, the crosswind limit for a Boeing 737 is just 35 knots.

What Happens when Airships are Damaged?

Some people believe airships pop like balloons when accidentally punctured, but that's a misconception. Airships are under no significant internal pressure, nor are they elastic. In war, rigid airships have survived flak and exploding artillery and flown hundreds of miles afterwards.

Even small, inflatable blimps are capable of enduring hundreds of bullets and still returning to base. However, blimps will gradually become uncontrollable as they deflate. To prevent this, airships like **Pathfinder** have rigid skeletons enclosing many gas cells. Compartmentalisation can save an airship from catastrophic damage that a single-hulled balloon or blimp could never survive.

Is Helium Disappearing?

Airships' rarity is often blamed on the scarcity of helium, but helium isn't prohibitively expensive. It represents a small share of an airship's operating costs, which in total are only a fraction of a cargo helicopter's operating costs.

There's also a rumour that the planet is imminently running out of helium. In reality, helium infrastructure is ageing out without replacement, causing occasional shortages. Humanity only captures 1.25% of the helium in natural gas, and massive new reserves are discovered regularly. Like rarer gases such as Xenon, helium can also be sequestered from air. It is continuously replenished by radioactive decay, with no need for fantasies of nuclear fusion or space mining.

In 2021, **Air Liquide** revolutionised helium refining using membranous filters. This provides 'exceptional value' compared to the old cryogenic extraction method. Their $32 million Saskatchewan pilot plant is tiny, yet produces enough helium for dozens of airships. Notably, over 80% of their operational costs go to the final compression of helium into tanks, which airships don't need on-site.

Lastly, some argue that hydrogen is viable with proper fireproofing. Hydrogen is cheap, widely available, and has 7% more lift. Some proposals seek to inert it with a barrier of nitrogen or helium to prevent explosions, as fuel tankers and airliners do today. Using hydrogen for lift is illegal in most countries, though, so the only hydrogen on modern airships would be in fuel cells, not gas cells.

Airship Economics: When is Bigger Better?

So if safety, weather, and helium availability weren't the cause of airships' decline, then what was? The reason is simple: they're slow.

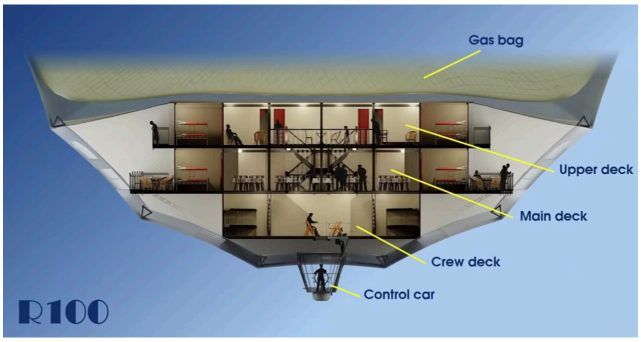
Even if the **Hindenburg** never crashed, airships couldn't have competed against the aviation breakthroughs World War II produced. Pre-war, passenger airships only competed against slower ocean liners. Post-war, jet travel killed the ocean liner so thoroughly that only one still operates today, and that industry was thousands of times larger and more well-established than airships had ever been.

In lieu of long-distance transit, airship companies need new economic niches, not just low-volume advertising and humanitarian aid. Instead of speed, airship companies offer efficiency. To hit ambitious decarbonisation targets, Spanish airline Air Nostrum has ordered ten Airlander airships to serve as 'fast ferries.' Their proposed short-haul, island and inter-city flights will reduce the difference in travel time.

Sadly, sustainability alone isn't sufficient. Airships still need to make money, and scalability is their major advantage. For instance, the 18-passenger **Gulfstream G500** costs $45 million. The larger **Boeing BBJ 777-9** seats 25-86, costs $544–$629 million, and took billions to develop.

Pictured: a Gulfstream G500, the finest pressurised tube that 45 million dollars will buy. The cabin is about the size of a school bus, 329 square feet. Source: Wikimedia

Compare and contrast the R100, a 1929 airship with a 'small hotel' for 100 people which cost £471,113, or ~$42 million today. That's the same passenger capacity as Air Nostrum's new airships, and nearly identical cost.



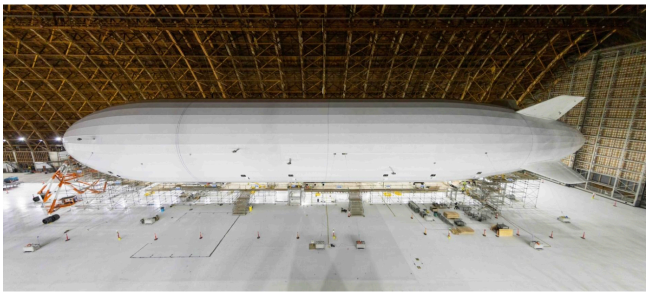
There were three decks covering 6,000 square feet of space, not counting the gondola, cargo holds, and other crew areas. That's significantly more space than even Air Force One. Source: Airship Heritage Trust.

In the 1920s, one could cross the Atlantic in two days aboard an airship with breathtaking floor-to-ceiling windows, balcony staterooms, a 56-seat dining room, world-class chefs, and a double grand staircase. In the 2020s, airlines insist that getting imprisoned in a tiny half-cubicle for a day is the height of opulence. Passengers pay about as much for first class flights ($8000-$10,000 with Emirates) as they did for an airship voyage in 1937 ($400, or circa $8,500 today).

A difficult choice: a pressurised tube or fine dining in sweeping Art Deco grandeur. Decisions, decisions. Source: Wikimedia, Airship Heritage Trust.

LTA's priority is disaster relief, but their Pathfinders can be configured for cargo or passengers. With their current lead, they could secure a share of the estimated $270 billion air cargo industry and $30 billion luxury aircraft market. The more airships they make, the cheaper each one gets.

LTA's First Principles Approach: Manufacturing from the Ground Up



Pathfinder 1 sits in its construction scaffold. This 'smaller' 400-foot (122m) prototype is the current largest aircraft in the world, at least until the 610-foot (185m) Pathfinder 3 takes flight. Source: LTA Research.

LTA's CEO Alan Weston has made manufacturing the focus of LTA's business strategy. Few airships have ever benefited from automation or mass production. Recently, Weston claimed to have "accelerated airship construction by over a factor of 10."

LTA does not advocate one 'silver bullet' innovation. Instead, they're modernising all aspects of airship design, materials, and manufacturing. They're using 3D printing and a vertical supply chain to streamline production and rapidly test new prototypes.

Externally, LTA's **Pathfinder** airships are pragmatically simple. They resemble a solarpunk remix of the smaller Zeppelin NT, a long-established model from which LTA sources its gondola and fins. The cylindrical shape is slightly less aerodynamic than complex curvature, but far easier to manufacture.

Internally, the design is far more unconventional. **Pathfinder's** hull is geodetic, a structure that confers extraordinary strength and durability. This rigid hull supports manoeuvring thrusters across the ship, as well as a ballasting system. These are powered by interchangeable combinations of batteries, solar cells, fuel cells, or generators. Past airships got much lighter as they burned liquid fuel, but **Pathfinders** use their largely fixed weight to anchor themselves while transferring cargo.

Design is one thing, but LTA's innovation lies in the manufacturing process itself. Airship hulls were once made from as few as 13 standardised parts, but assembly was labor-intensive and vertiginous. LTA's patented construction rig allows their hulls to be built from the ground up and rotated, like a vast Ferris wheel. This approach is safer, and requires far less manpower.

Materials have also come a long way in the last century. Synthetic sailcloth is ten times stronger than traditional blimp cotton. Carbon fibre is more than three times stronger than Zeppelins' aluminium. These materials have come down in price by an order of magnitude in recent years. Just as the advent of cheap, powerful batteries revived the electric car, LTA is betting that advanced materials will do the same for airships.

The Future, Starting from Square One

With those first principles addressed, the future of LTA's project must be considered. There are enormous economic and institutional obstacles to creating an industry from scratch. The question remains, will LTA be the company to finally overcome these problems?

Even once the prototype is completed, there remains the costly, complex issue of certification and testing. If prototype airplanes fatally crash, it doesn't jeopardise airplanes, but one harmless airship mishap can create a storm of bad press.

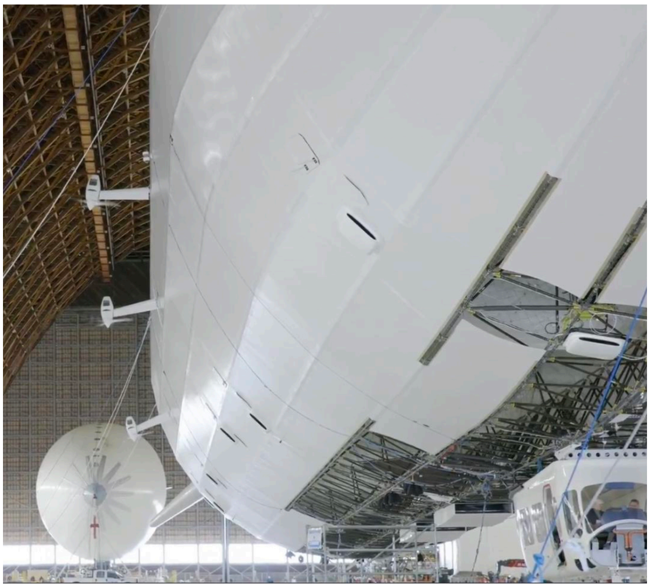
Granted, most of these hardships can be overcome through the judicious application of money. In that regard, LTA is more well-positioned than the vast majority of previous projects. They have over 200 employees, as well as collaborations with the **University of Akron, Kilwell Fibrelab**, and the highly experienced **Zeppelin Company,** among others. They also have access to two gargantuan, historic airship hangars, and private funding to the tune of hundreds of millions of dollars.

LTA still might fail to revive the airship, but it's important to remember all the reasons they could succeed. Aviation historian Dan Grossman is highly skeptical of airship vapour-ware, but said that "LTA Research are smart, serious, and first class in every way; I have no doubt this will be a successful and wonderful project."

There is reason for optimism. In the '20s and '30s, the **Graf Zeppelin** became an international phenomenon. Her career reads like the service history of the starship **Enterprise**. She circumnavigated the globe, embarked on a polar expedition that changed the maps, fought vicious storms at sea and visited countless major cities. She became the world's first transatlantic airliner, and the first aircraft to fly over a million miles.

Graf Zeppelin achieved these amazing firsts with little more than hydrogen, sailcloth and determination, despite being a mere experimental prototype.

With a century's countless engineering advancements and safety measures in their favour, LTA isn't setting their sights any lower for their Pathfinders. They intend to return airships to the rescue missions they once performed. In time, they might recapture the lost romanticism and awe that captivated the world a century ago.



Pathfinder 1 *conducts its first hover test, using its propeller nacelles to vector thrust downward. This gives the ship low-speed hover and pitch control. Source: LTA Research.*