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Supersonic Travel

The Need for Speed

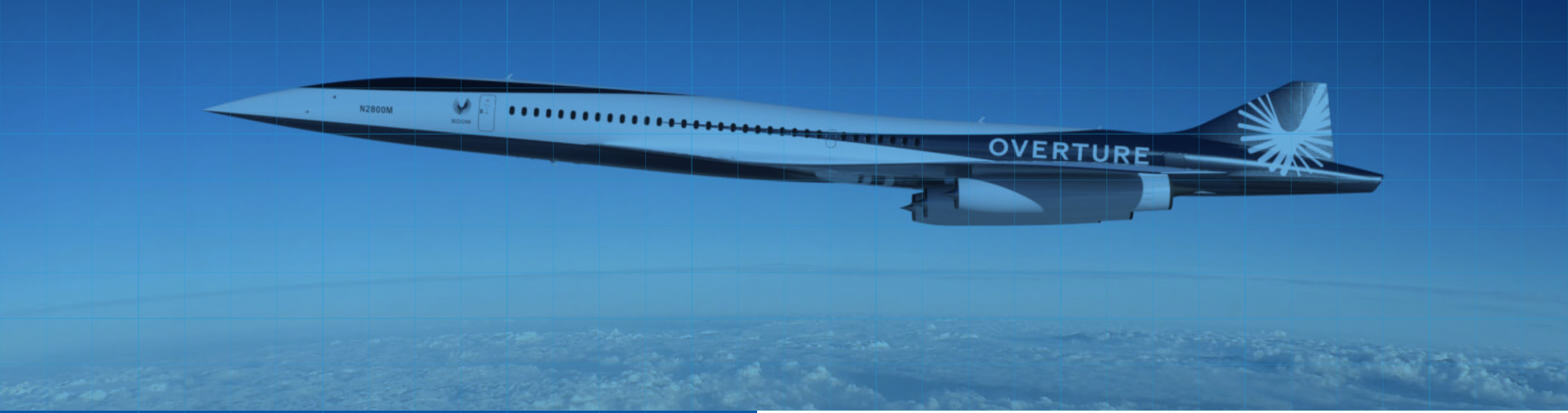


Image Credit: Boom Supersonic

Included in this edition

Go faster—a perpetual objective that is integrated into just about every aspect of our lives. Modes of transportation are no exception. Trains, planes, and automobiles have gotten faster and faster since their inception. Bullet trains—check! Ludicrously fast electric cars—check! Supersonic commercial airplanes—well, not anymore. There was a period where air passengers sped beyond the sound barrier, but this ended over 20 years ago. Since then, commercial air service has been limited to subsonic speeds. However, in recent years there has been renewed interest by Airlines, National Aeronautics and Space Administration (NASA) and the public, fostering the development of a second generation of supersonic commercial aircraft. These aircraft are being designed to overcome the shortcomings of earlier generations, offering quieter operations and greater affordability. But will most of us be able to afford and enjoy the time savings of supersonic travel? Will current flight regulations prevent supersonic commercial travel over the U.S. and abroad? These and many other questions have yet to be answered. To understand where Commercial Supersonic Technology (CST)[1]—a term coined by the NASA—is headed, it's best to first understand how we got to where we are today.

History of Speed & Commercial Air Travel

The speed and performance of aircraft have increased significantly since the early days of aviation when the Wright Flyer first became airborne over the dunes of Kitty Hawk in 1903. Once flight became safe, repeatable, and predictable, we pushed the envelope of flight altitude, distance, and speed. Innovative aircraft designs resulted in flight that approached supersonic speeds, which exceeded the speed of sound at approximately 770 mph (sea level).

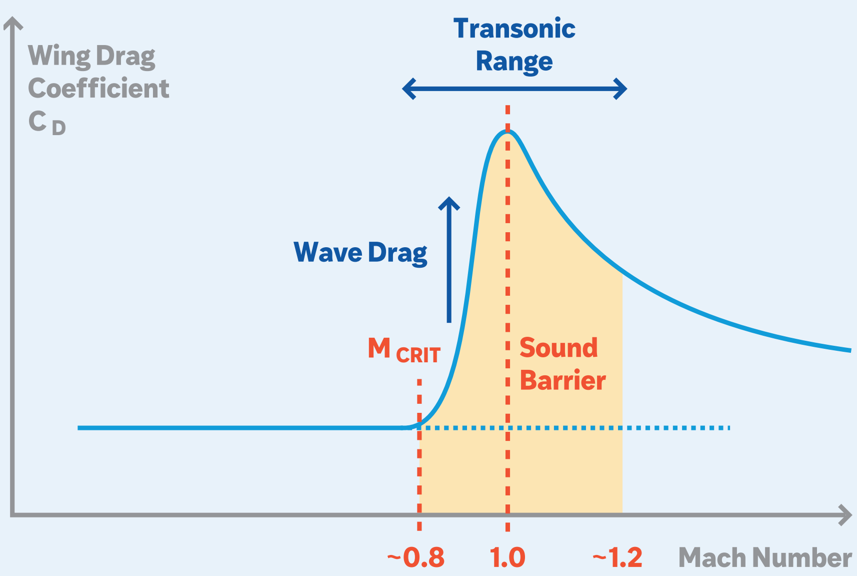
One of the biggest challenges of flying faster than the speed of sound was the "sound barrier"—a physical phenomenon that occurs when an object reaches "transonic" speeds. Aircraft reaching the speed of sound experience increases in "wave drag" (drag specific to transonic flight) rendering faster speeds more difficult to achieve. However, the advent of innovative aircraft designs following WWII coupled with the beginning of the Jet Age resulted in the breaking of the sound barrier by the Bell X-1 in 1947. Once past the sound barrier, as speed increases, wave drag becomes less and more manageable.

The complexities of supersonic flight limited its use to military and experimental programs. During this period, commercial aviation continued to fly subsonic, but with increasing speeds as commercial aircraft transitioned from propeller to jet engines. Modern jet engines and airframes are generally the most efficient around Mach 0.85, which has been the cruising speed for most commercial jet aircraft over the past four decades. Research supporting commercial jet aviation has focused on developing aircraft that are larger with greater passenger and cargo capacity, are more fuel efficient, quieter and with longer range.

A physical phenomenon associated with supersonic flight that quickly became an environmental concern was the sonic boom. This is a loud, at times thunderous sound, heard by people on the ground as a supersonic aircraft passes above.

Yet, even with these challenges to surmount, our drive to go faster eventually led to the development of supersonic commercial aircraft—integrating the knowledge gained by military and other experimental supersonic applications.

Starting in the 1960's, commercial aircraft manufacturers applied sound barrier-breaking designs to passenger aircraft—the European-built Concorde, shown below, and the Soviet-developed Tu-144. US airplane manufacturers, while experimenting with the technology, never developed a commercial supersonic aircraft.[2] These aircraft reached speeds twice the speed of sound (Mach 2) and nearly halved the travel time across the Atlantic, as well as routes between Moscow and Siberian cities during the 1970's. However, due to the impacts of sonic booms over land, the Federal Aviation Administration (FAA) in the United States prohibited supersonic flights to ensure that flights entering or leaving the U.S. would



Relationship of Wind Drag to Aircraft Speed (Mach Number)

Air France Concorde. Image Credit: Adobe Stock

not cause a sonic boom to reach the surface.[3] Therefore, limiting the Concorde to transatlantic flights from the U.S.

Despite these flight constraints, the Concorde set several records including the fastest transatlantic flight by British Airways from New York John F. Kennedy International Airport (JFK) to London Heathrow Airport (LHR) in 1996 in just under 3 hours, the fastest around-the-world flight in 1995 in just under 3 and a half hours (including refueling stops)[4], the fastest scheduled passenger service at approximately Mach 2 (≈1,350 mph), and the highest cruising altitude for a passenger aircraft of approximately 60,000 feet.

Although impressive for its speed records, the Concorde wasn't just synonymous with speed—it also meant exclusivity. When you flew on the Concorde, you were part of an era-defining luxurious experience built on innovative technology that included the double delta wing and the droop nose. Unfortunately, the glamourous existence of the Concorde was short-lived. The flawless image of the Concorde was blemished by a catastrophic accident in 2000 where Air France flight 4590 crashed shortly after takeoff from Paris killing all 109 onboard and 4 people on the ground, which resulted in the entire fleet being grounded for over a year. Economics and profitability also played important roles due to the high costs of operating the aircraft, which translated on relatively expensive ticket prices that were not sustainable. Lastly, the 9/11 travel climate that reduced business travel—the Concorde's primary source of income—sealed the aircraft's inability to remain in service. The Concorde's last flight was in 2003, in its 27-year lifetime, the Concorde served just over 2.5 million passengers[5] at supersonic speeds.

"the Concorde wasn't just synonymous with speed—it also meant exclusivity."

Like the Concorde, the Tu-144 struggled with significant challenges including operational inefficiencies and a fatal crash. Throughout its service life, the Tu-144 endured engineering issues due in part to the political urgency to win the title of first SST aircraft to fly in December 1968, roughly two months ahead of the Concorde. Also, flying on the Tu-144 was not a pleasant experience for its passengers who had to travel in a cramped, noisy, unstable cabin where the ride quality was notably rough. It's no surprise, then, that the Tu-144 carried passengers for only about eight months. For its remaining service life, the Soviet aircraft was relegated to research experiments and to carrying cargo and mail, before signing off on its final flight in June 1999.[6]

Overture. Image Credit: Boom Supersonic

State of Commercial Supersonic Travel

Did more than two decades of supersonic commercial aviation ultimately conclude in failure? Was it not a viable service? And will commercial passenger travel moving forward be limited to travel at only subsonic speeds? While this seemed to be the case in the decade following the Concorde's last flight, more recently, advancements in aviation technology and our understanding of supersonic speeds, sonic booms, along with sustainable fuels in the civil aviation realm have opened new opportunities for faster-than-sound travel. To support these efforts, the FAA Reauthorization Act of 2024 FAA Sec 1025 directed the FAA, in consultation with NASA and industry, to provide a briefing to Congress to identify any plans to build upon existing research and development and identify additional research needed to support the development of Federal and international policies, regulations, standards, and recommended practices relating to the certification and operation of civil supersonic aircraft and supersonic over-land flight.

This level of coordination has paved the way for industry stakeholders to develop innovative technologies to address the needs of supersonic commercial aviation. Boom Supersonic, as one example, has developed the XB-1, a single-seat, jet fighter-like experimental aircraft used to test "boomless" technology, which allows the aircraft to fly at supersonic speeds while creating a sonic boom that is either not audible or barely audible by people on the ground. This technology and test flight findings are being applied to the development and production of a larger-scale 60 to 80 passenger commercial supersonic aircraft called Overture, shown below. Initial testing indicates that speeds up to Mach 1.3 could be achieved over land. Speeds between Mach 0.85 and Mach 1.2 are not likely to be economical because of the wave drag at transonic speeds. Major stakeholders like American, United, and Japan Airlines have already signed agreements to purchase or have options on approximately 100 aircraft, which are anticipated to roll out in 2026 and carry passengers by 2029 or 2030.[7]

NASA and Lockheed Martin have been developing the X-59 QueSST (Quiet Supersonic Technology), also a single-seat, jet fighter-like experimental aircraft that is expected to fly at supersonic speeds, generating a "quiet thump" rather than the typical sonic boom. NASA doesn't plan on building a commercial supersonic aircraft, but instead plans to prove that an aircraft can fly at supersonic speeds without creating a sonic boom. The X-59 project has three phases: 1) Aircraft Development, 2) Acoustic Validation, and 3) Community Response. This project is currently at the latter stages of Aircraft Development. Unlike the Boom Supersonic project, NASA's X-59 is slated to perform supersonic flights over cities to gauge community response and feedback on the impact of the flight's sonic "thump." The X-59 is scheduled to make its first flight in 2025.

Going even faster, beyond supersonic, is the nascent frontier of hypersonic travel–flight speeds higher than five times the speed of sound (Mach 5). Although much of the commercial hypersonic aircraft development is still at the research stage, the Venus Stargazer M4 has advertised its intent to carry passengers at speeds as high as Mach 9 by as early as 2030. Other major players are Boeing, Exosonic, JAXA, Virgin Galactic, and Eon Aerospace, have also indicated interest in developing commercial hypersonic aircraft. At hypersonic speeds, an aircraft's range increases by sevenfold when compared to the conventional subsonic Boeing 787 Dreamliner.

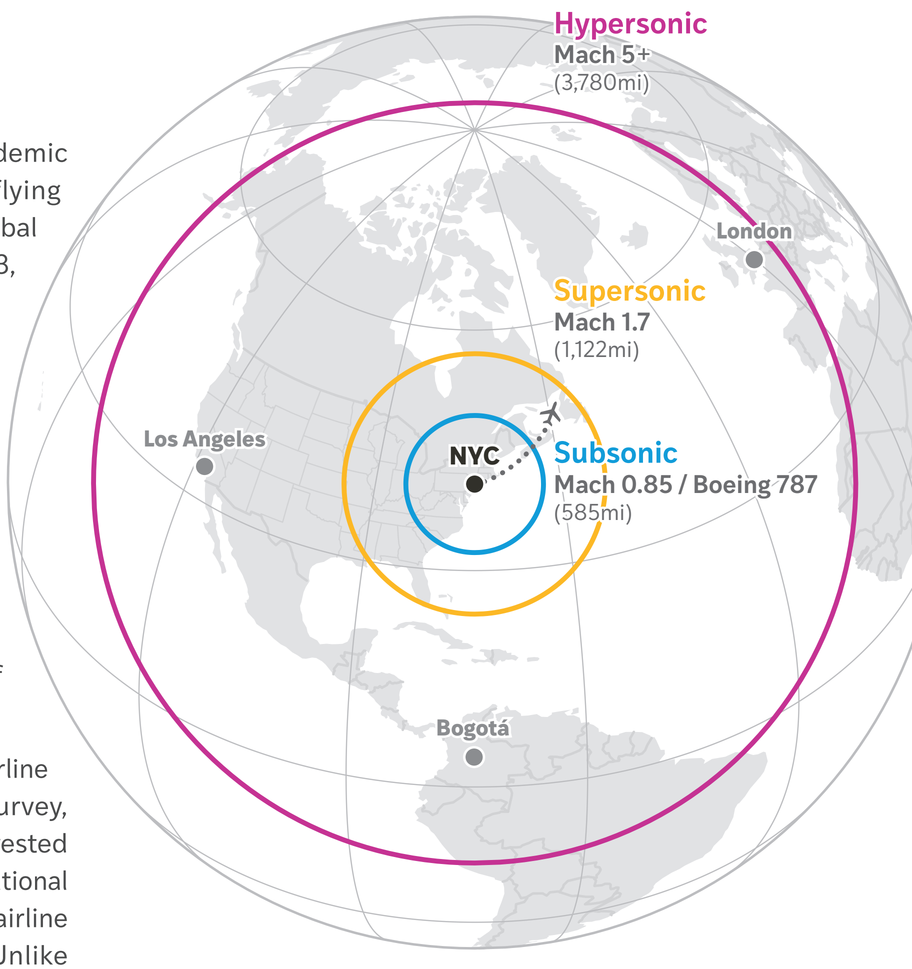
Future Market and Demand

Global travel demand finally surpassed pre-pandemic (2019) levels in 2024—people are once again flying more than ever. Aviation forecasts show that global passenger traffic will more than double by 2053, reaching 22.3 billion annual passengers, with China, the U.S., and India leading as the top three markets.[8] A survey conducted by Boom Supersonic found that 94% of corporate travel managers believe that supersonic air travel will be commercially available by the early 2030's. It's believed that faster travel promotes passenger wellness by decreasing the duration of the travel process and increasing productivity at the destination in the case of business travel, or the enjoyment of the destination itself in the case of leisure travel.

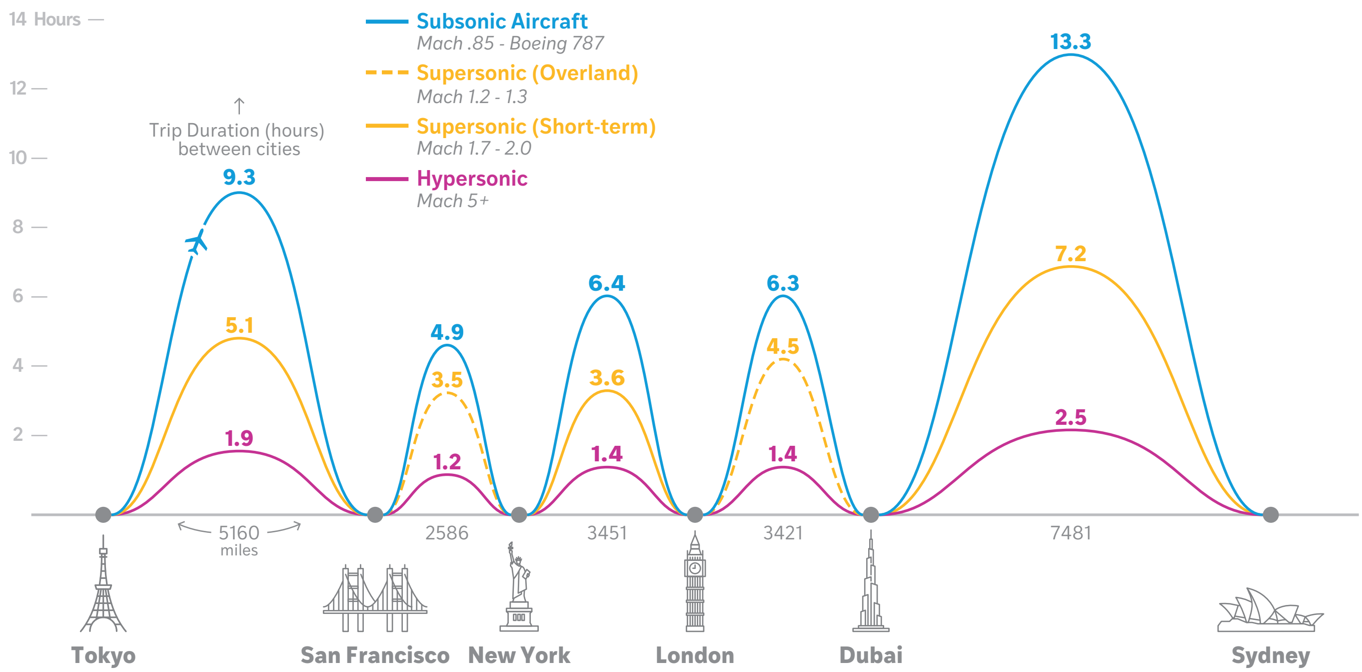
The speed of travel could become a criterion for airline and air fare selection. According to the same survey, 97% of global premium fare passengers are interested in flying on a supersonic flight for long-haul international trips, and 87% would switch from their preferred airline in order to gain access to supersonic travel.[9] Unlike the limited routes flown by the Concorde due to noise restrictions, future supersonic routes could incorporate transcontinental routes across North America and Asia, for example, creating the opportunity to a wider range of city-pair markets. To illustrate the flight time savings of faster than sound aircraft, the chart below shows the approximate duration of flights between a few major destinations by the Boeing 787 Dreamliner, supersonic aircraft, and hypersonic aircraft.

“The speed of travel could become a criterion for airline and air fare selection.”

Approximate Distance Traveled in One Hour



Comparison of Flight Time Durations



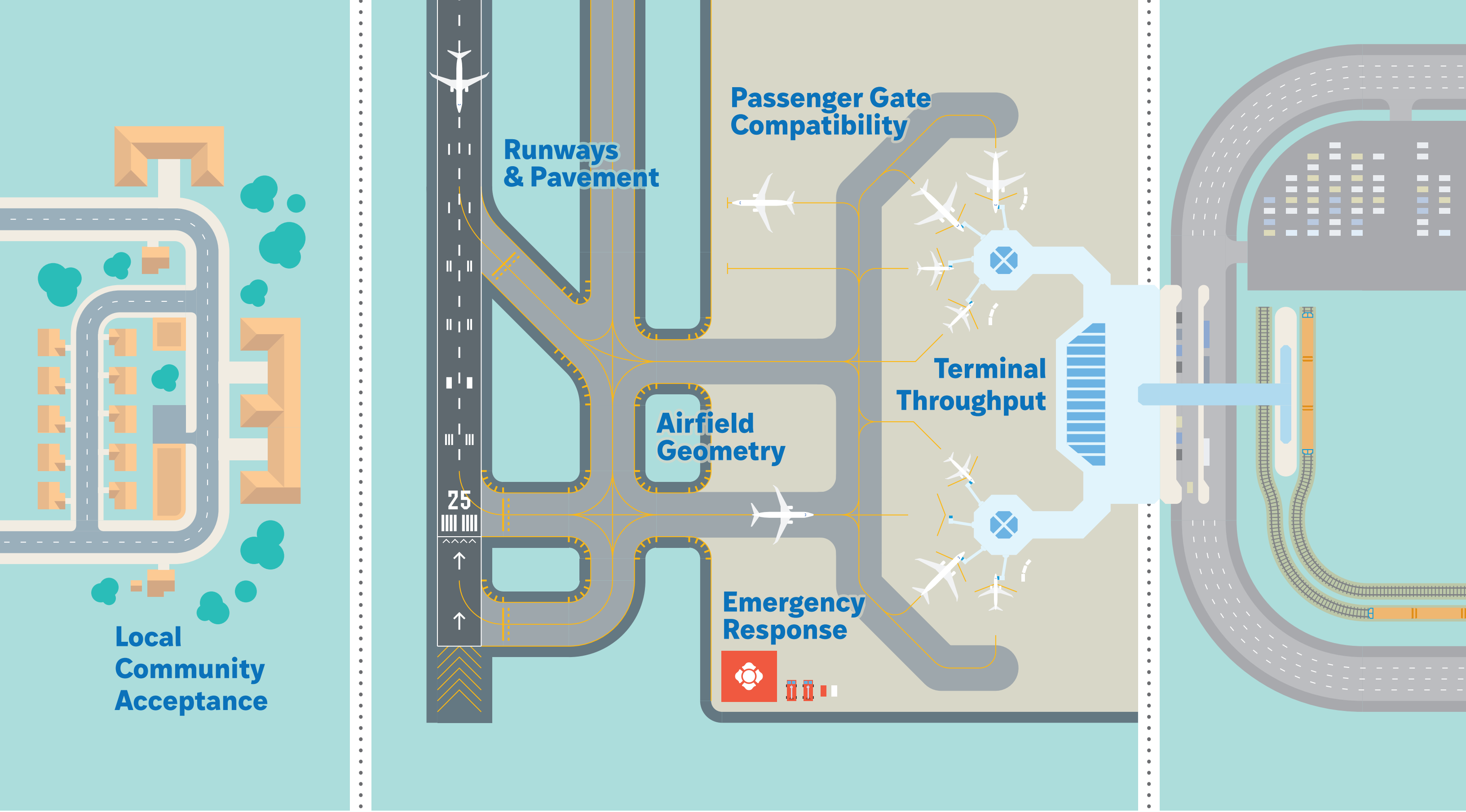
Relative to pricing, business and first class travelers amount to 12% of airline passengers, but account to as much as 75% of airliner profits due to their higher air fares.[10] Given that Boom Supersonic anticipates that their aircraft operating costs will enable fares similar to current business-class fare (≈ $5,000 from New York to London), supersonic travel could become an attractive alternative for current business and first class travelers. Airlines could also see this as part of a strategy to retain and attract high-value business and first-class customers who are being courted by increasingly affordable private charter services (jet shares). However, segmenting a portion of premium fare passengers to a new supersonic fleet may reduce the profitability of subsonic flights. Supersonic aircraft will likely show up on routes that have a sufficient volume of premium class passengers, enabling an airline to have a percentage of passengers use supersonic aircraft without jeopardizing the profitability of subsonic flights that serve the same markets.

Airspace Management Challenges

Commercial supersonic travel will reintroduce a few unique challenges to current largely subsonic air space management. Supersonic aircraft will need consistent access to climb and descent corridors that reach higher altitudes where supersonic flight occurs. The good news is that these corridors to access high altitude airspace can be located outside the most congested portions of low altitude airspace near large-hub airports. Unlike subsonic flights, supersonic flights will occur at altitudes that are mostly above weather and variable winds. Thus, supersonic flight routes stay in the same locations, rather than shift from day to day to catch favorable winds. In low altitudes, supersonic aircraft fly at subsonic speeds and thus can use the same airspace as other subsonic aircraft. The Concorde was an Approach Category D aircraft with a landing speed of 162 knots. Approach Category D aircraft also include the Airbus A340, B737-800/900/Max, B747 and B787.

Currently, all civil aircraft flights are prohibited from flying at speeds above the speed of sound over land. But parties seeking to perform the testing of civil supersonic aircraft may do so by obtaining a Special Flight Authorization (SFA) from the FAA.

While Supersonic operations are not expected to overwhelm the National air Space (NAS) in the same way as vertical space launches, which were discussed in the previous publication on *The Intersection of Commercial Aviation & Space Travel*, they do demand proactive NAS adaptations. In other words, NAS will have to accommodate "Spaceport corridors" for commercial space travel and now "Speed corridors" for commercial supersonic travel.



Challenges Before Takeoff

Impact on Airports

Many U.S. airports are already well-positioned to support the next generation of supersonic commercial aircraft. Decades of post-Concorde investment—including runway extensions, pavement reinforcement, and enhancements to aircraft rescue-and-firefighting (ARFF) capabilities—have equipped major hubs such as JFK, LAX, ORD, DFW, and ATL with the core infrastructure necessary for high-speed takeoffs and landings. Typically, runways measuring between 10,000 and 12,000 feet already meet the longer-distance requirements, and existing pavement strength comfortably handles wheel loads comparable to those of today's largest widebody aircraft. Some of the existing airport infrastructure strengths include:

Runways & Pavement

Existing runways meet or exceed length and strength requirements; only a handful of smaller airports will need modest extensions or Engineered Material Arresting System (EMAS) beds for aborted-takeoff safety.

Airfield Geometry

Airfield geometry includes taxiways, aprons (parking areas), fillets (corner radii), and the spacing between parallel taxiways/runways. These dimensions determine whether an aircraft can safely taxi, turn, park, and be serviced without striking obstacles or other aircraft. Taxiway separations, wingtip clearances and apron layouts at major airports already conform to design-group standards that supersonic airframes will fall under. The Concorde had an ~84 ft wingspan—that puts it in ADG III.

Passenger Gate Compatibility

Current designs target compatibility with standard widebody gates and jet bridges, minimizing the need for bespoke ground-support equipment or terminal renovation.

Terminal Throughput

Faster gate turns (potentially doubling daily rotations) will shift bottlenecks to landside elements like security checkpoints, immigration halls, baggage carousels, concourses, curbside, and parking garages unless airports invest in automation, additional flexibility, and dynamic gate-assignment systems. Additional bottlenecks may develop at landside elements like curbside and parking garages.

Emergency Response

ARFF services include fueling, towing, ground power, and basic maintenance. These determine how safely an airport can respond to incidents and service aircraft. U.S. airports handling large jets are already ARFF Index E–compliant, ensuring sufficient firefighting vehicles, foam supplies and trained personnel for supersonic operations.

Local Community Acceptance

Modern low-boom commercial supersonic aircraft must not only comply with FAA noise rules, but also secure acceptance from local communities around airports with supersonic aircraft service. Airports generally work with local communities to ensure the quietest aircraft types operate at the airport. Airports will have to educate community members and monitor supersonic aircraft operations to address the community's expectations. Additionally, local curfews or special procedures may limit operating windows even when runway infrastructure is ready.

Dynamic Policy Conditions

Current FAA regulations prohibit civil aircraft from flying over the U.S. at speeds greater than Mach 1, the speed of sound, due to the sonic boom associated with exceeding the speed of sound. For years, aircraft manufacturers have worked on developing airframes that could fly at speeds faster than Mach 1 without creating a sonic boom. For example, NASA plans to fly their X-59 aircraft at supersonic speeds over microphones on the ground to acoustically validate that the aircraft produces noise levels lower than a sonic boom. Recently, a Presidential Executive Order instructed the FAA to repeal the prohibition of over-land supersonic flights, establish an interim noise-based certification standard, and repeal other regulations that hinder supersonic flight.[11] This may speed up the development and production of the full-scale commercial supersonic aircraft that are currently in the concept and testing phases. Communities under commercial supersonic routes may still complain about noise, therefore commercial supersonic aircraft and engine manufacturers should continue to develop technologies to lessen the sonic boom noise impacts, especially for routes passing over highly populated areas.

Other nations around-the-world also prohibit commercial supersonic flights within their airspace due to noise. Therefore, without amending foreign policies on commercial supersonic aircraft noise, airlines will be limited to routes over water—similar to the earlier Concorde flight restrictions.

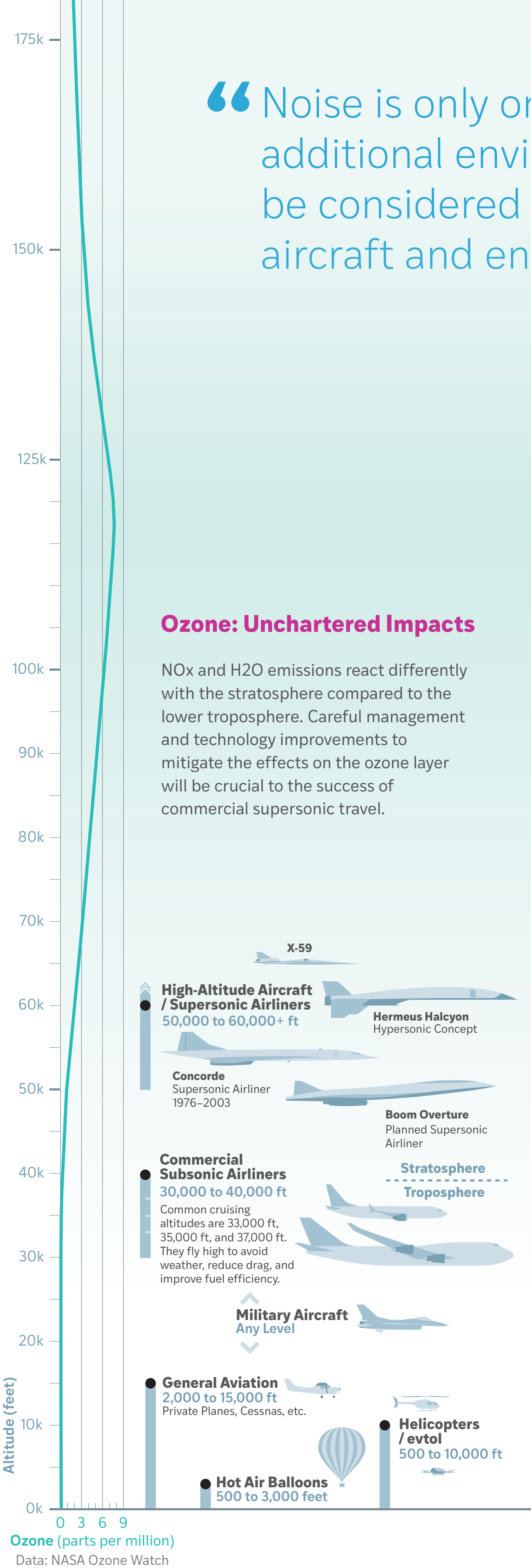
Beyond Noise: Broader Environmental Challenges

Noise is only one environmental concern—additional environmental challenges must be considered and mitigated as supersonic aircraft and engines are developed. One of these challenges is fuel burn and emissions. Although current aircraft designs are expected to burn about half as much fuel per seat mile, supersonic aircraft burn significantly more fuel than their subsonic peers with nearly half the passenger seats, more than doubling the carbon footprint per passenger. One solution that is being explored to reduce emissions is the use of Sustainable Aviation Fuel (SAF).

SAF is an alternative fuel that reduces emissions and is made from non-petroleum feedstocks. Currently, SAF is blended with traditional Jet A fuel for it to be compatible with existing aircraft.[12] Several airlines and engine manufacturers are experimenting with using 100% SAF. In fact, Virgin Atlantic made history in 2023 flying their Boeing 787-9 Dreamliner powered by Rolls-Royce Trent 1000 from London to New York using 100% SAF. Boom's passenger supersonic airliner, Overture, will also be optimized to run on up to 100% SAF using their Symphony engine.[13] While SAF appears to be a key means of achieving ICAO's goal of net zero carbon by 2050, it does come with its own set of demand challenges that the aviation industry must contend with.

The demand, and therefore production, for SAF is steadily increasing as aviation attempts to shrink its environmental impacts. Although SAF emits less emissions than Jet A fuel, the substantial fuel requirements for supersonic aircraft and the additional effects of emissions in the stratosphere may outweigh the climate benefits of SAF. Commercial supersonic aircraft are expected to fly around 50,000 to 60,000 feet in altitude compared to commercial subsonic aircraft, which fly between 30,000 to 42,000 feet. Due to the composition of the upper stratosphere, NO_x and H_2O emissions react differently with the stratosphere.

> “Noise is only one environmental concern—additional environmental challenges must be considered and mitigated as supersonic aircraft and engines are developed.”



Ozone: Unchartered Impacts

NOx and H2O emissions react differently with the stratosphere compared to the lower troposphere. Careful management and technology improvements to mitigate the effects on the ozone layer will be crucial to the success of commercial supersonic travel.

These emissions at a higher altitude are correlated with a large depletion of ozone and changes to radiative forcing, further affecting Earth’s climate. Therefore, careful management and technology improvements to mitigate those effects will be crucial to the success of commercial supersonic travel.

Unfortunately, the current production levels of SAF are below what is necessary to fully support commercial supersonic flights at scale. In 2024, The U.S. SAF production was approximately 343 million gallons—doubling 2023 levels—but still below projected estimates.[14] The Biden Administration created the SAF Grand Challenge, a strategy between government agencies to produce 3 billion gallons by 2030. To meet this goal, production would need to increase by approximately 800%.[15] As demand grows, new energy plants are coming online, but it is still uncertain if the constraints can be overcome and provide sufficient SAF for the expected demand of 5.7 billion gallons in 2030.[16] On top of limited production facilities, SAF can be up to five times more expensive to create compared to traditional Jet A fuel, adding an additional cost to an already costly aircraft operation. This cost will likely be passed on to passengers, making supersonic flights unaffordable for most.[17] Fortunately, today’s commercial supersonic aircraft manufacturers are expecting their aircraft to consume half as much fuel per passenger as the Concorde.

A Faster Future

Nearly every aspect of commercial aviation has continuously improved over the last 50 years—except for the speed of travel. The Concorde was an aspiring chapter in aviation that ended too soon. Over the decades since its last flight, considerable advances in aircraft aerodynamics and propulsion have been achieved, leading to substantial improvements in performance and efficiency. The continued investments by aircraft manufacturers and airlines underscore their expectation of a positive trajectory for the future of aviation. The reintroduction of commercial supersonic travel promises to significantly enhance the passenger travel experience by restoring something that is lost during conventional air travel—time—while connecting distant cities and transforming the way we engage the world. Although many challenges remain, growing passenger demand and resilient aircraft innovation are advancing forward on converging paths.

Commercial supersonic flight promises to decrease environmental impacts and become a truly sustainable form of travel—an advancement that could help gain both regulatory approval and public acceptance. In the grand tapestry that is air travel, commercial supersonic travel could be the rewoven thread that pulls the aviation industry forward to a new Jet Age with both supersonic and hypersonic travel. It's almost difficult to fathom. But then again, what would the Wright brothers think if they returned over 100 years later, and saw how every day, millions of air passengers effortlessly take to the skies and circumnavigate the globe in mere hours. Future generations will witness new forms of transportation unimaginable today, driven by our relentless pursuit to go faster!

> "Future generations will witness new forms of transportation unimaginable today."

Endnotes

1 Supersonic Transportation (SST) is how the Federal Aviation Administration (FAA) classifies this type of travel.

2 The US entered the SST race with the Boeing 2707 program that aimed at building an overambitious swing-wing airframe, 300-passenger jet that would fly at Mach 2.7 (faster and larger than the Concorde). However, the program faced soaring cost overruns, rising environmental concerns, and intense political opposition which led Congress to cancel federal funding in 1971, effectively ending the program before a prototype ever touched the sky.

3 14 CFR § 91.817 (b) (1)

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The LAB is Landrum & Brown's research and development unit. Our mission is to harness decades worth of industry knowledge and expertise to develop innovative solutions that support our clients along with promoting industry thought leadership.

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