United States Government Accountability Office

GAO

Report to Congressional Requesters

August 2007

VERY LIGHT JETS

Several Factors Could Influence Their Effect on the National Airspace System

GAO-07-1001

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GAO Accountability · Integrity · Reliability

Highlights

Highlights of GAO-07-1001, a report to congressional requesters

Why GAO Did This Study

For several years, a number of aviation manufacturers have been designing and testing very light jets, a type of small jet aircraft equipped with advanced technologies and priced below other business jets. Aviation forecasters predict that thousands of very light jets will enter the National Airspace System (NAS) over the next two decades, contributing to the overall growth of the general aviation fleet. While some experts predict that very light jets will be used in ways that are similar to current general aviation aircraft, others predict that they will be used to expand the air taxi market to provide on-demand, point-to-point air transportation. In 2006, the Federal Aviation Administration (FAA) certified the first very light jets for flight. This report identifies (1) current very light jet forecasts and what factors could affect very light jet deliveries, (2) how increasing numbers of very light jets might affect the capacity and safety of the NAS, (3) how FAA is planning to accommodate the entry of very light jets into the NAS, and (4) how very light jets might affect FAA's costs and Airport and Airway Trust Fund revenues. To address these issues, GAO reviewed relevant documents and interviewed agency officials and aviation experts.

GAO is not making recommendations in this report. The Department of Transportation provided technical clarifications, which were incorporated as appropriate.

www.gao.gov/cgi-bin/getrpt?GAO-07-1001.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Susan Fleming at (202) 512-2834 or flemings@gao.gov.

What GAO Found

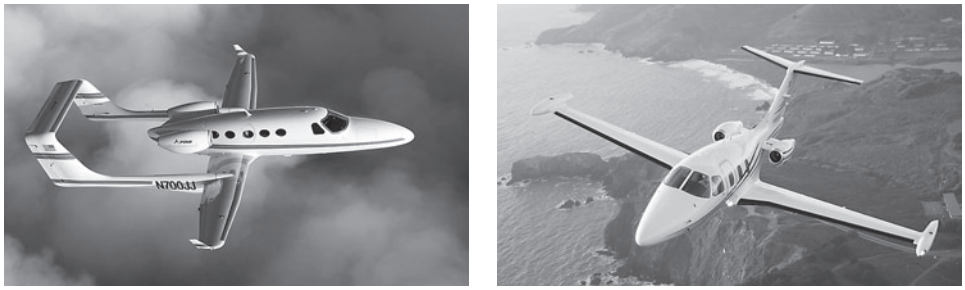
The eight very light jet forecasts GAO examined provided a range of both the number of very light jets projected to be delivered (roughly 3,000 to 7,600) and the dates by which those numbers would be reached (from 2016 to 2025). The forecasts were based on limited information about the market for very light jets and varied based on a number of assumptions, particularly regarding the development of the air taxi market.

The studies GAO reviewed and the experts GAO contacted expressed varying opinions about the impact of very light jets on NAS capacity; however, most of the experts believed that very light jets would have little overall effect on safety. The studies found that the type of airports used by very light jets will influence very light jets' effect on capacity. Experts also mentioned other factors that could affect capacity such as aircraft usage, trip length, and altitude. Most experts GAO contacted believed that very light jets will likely have little impact on safety due to FAA's certification procedures for aircraft, pilots, and maintenance.

According to FAA officials, the agency currently has policies and procedures in place to accommodate the entry of very light jets into the NAS because the aircraft will operate similarly to other aircraft and will enter the NAS incrementally. Nonetheless, FAA is taking steps to address issues associated with very light jets by establishing a cross-organizational group to facilitate communication about very light jets across the agency. In addition, FAA expects that the deployment of modern air traffic management technologies will help to integrate very light jets in the long run.

The impact of very light jets on FAA's costs and Trust Fund revenues will depend on factors such as the number of very light jets deployed, the extent to which they replace existing aircraft, and whether they facilitate a large-scale air taxi industry. The Congress is considering legislation that could affect how very light jets are taxed but, as with the current funding structure, there is too much uncertainty about very light jets to accurately compare the revenue effects of these proposed alternative funding structures.

Examples of Very Light Jet Aircraft



Source: Adam A700; Adam Aircraft Industries (left), and Eclipse 500; (c) copyright, Eclipse Aviation Corporation, 2007 (right).

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Abbreviations

ADS-B	Automatic Dependent Surveillance-Broadcast
FAA	Federal Aviation Administration
MIT	Massachusetts Institute of Technology
NAS	National Airspace System
NASA	National Aeronautics and Space Administration

GAO
Accountability * Integrity * Reliability

United States Government Accountability Office
Washington, DC 20548

August 24, 2007

The Honorable John Mica
Ranking Republican Member
Committee on Transportation and Infrastructure
House of Representatives

The Honorable Jerry Costello
Chairman
The Honorable Thomas Petri
Ranking Republican Member
Subcommittee on Aviation
Committee on Transportation and Infrastructure
House of Representatives

For several years, a number of aviation manufacturers have been designing and testing very light jets, a new type of small jet aircraft that are priced below other business jets and which will come equipped with advanced avionics and can be certified for single-pilot operation. In 2006, the Federal Aviation Administration (FAA) certified the first very light jets to fly in the National Airspace System (NAS). According to very light jet manufacturers, six very light jets had been delivered as of March 31, 2007. Business aviation forecasters predict that thousands of very light jets will enter the airspace over the next couple of decades, some of which may be used for air taxi operations (i.e., on-demand point-to-point air transportation service), contributing to the overall growth of the general aviation fleet. Some industry experts have raised concerns about increased congestion resulting from very light jets' entry into the NAS given projected growth in commercial air travel, which FAA predicts will increase from 740 million passengers flying in fiscal year 2006 to 1 billion passengers in 2015.

Recognizing that the current aviation system cannot expand to meet this projected growth in demand for air travel, FAA currently is involved in a multiagency planning effort to transform the nation's current air traffic control system to a more modern system that is intended to safely accommodate a possible tripling of air traffic by 2025. As FAA works to begin implementing improvements to the air traffic system, the question of how to fund this modernization effort has come under review, especially since most of the excise taxes that go into the Airport and Airway Trust Fund (Trust Fund)—which funds most of FAA's budget—are scheduled

for reauthorization at the end of fiscal year 2007. Because of the importance of meeting the nation's air transportation demands, you asked us to study the possible effects of the introduction of very light jets on the NAS and on FAA. Accordingly, we addressed the following questions: (1) What are the current forecasts for very light jet deliveries and what factors could affect very light jet deliveries? (2) How might increasing numbers of very light jets affect the capacity and safety of the NAS? (3) How is FAA planning to accommodate the entry of very light jets into the NAS? (4) What factors will influence very light jets' effect on FAA's costs and Trust Fund revenues?

To identify current forecasts for very light jets, we reviewed government, academic, and aviation industry studies and interviewed aviation experts to compile a list of publicly and commercially available forecasts. We selected eight forecasts to review on the basis of criteria that we established (e.g., being published within the past 12 months and providing a specific number of aircraft within a timeframe). We reviewed the forecasts and determined that they were sufficiently reliable for our purposes. To identify factors that could affect the number of very light jets delivered, we obtained information from organizations and individuals with expertise in general and business aviation. To determine how increasing numbers of very light jets could affect the capacity and safety of the NAS, we reviewed industry studies and interviewed government officials and aviation experts. To understand how FAA plans to accommodate potential very light jet demand, we met with FAA officials to discuss how FAA handles new aircraft and its plans for modernizing the air traffic control system. We also asked selected government and industry organizations to identify what actions FAA should be taking to prepare for very light jets. To determine the effect of very light jets on FAA's costs and Trust Fund revenues, we met with FAA officials to discuss the way they allocate costs to aviation users, including very light jet operators, and the taxes that are typically paid by general and business aviation users. We discussed how the administration's reauthorization proposal would treat general and business aviation users, including very light jet operators. We reviewed congressional alternatives to the administration's proposal. We also discussed aviation taxes with excise tax experts from the Internal Revenue Service's Office of Chief Counsel. We conducted our work from September 2006 through July 2007 in accordance with generally accepted government auditing standards. See appendix I for a more detailed explanation of our scope and methodology.

Results in Brief

The eight forecasts we examined provided a range of both the number of very light jets projected to be delivered (roughly 3,000 to 7,600) and the dates by which those numbers would be reached (from 2016 to 2025). The factors used to estimate the number of very light jets and the assumptions about them varied. Factors that might affect the number of very light jet deliveries, according to the forecasts, included the development of the air taxi market, economic growth, production constraints, insurance and training requirements, and expected aircraft retirements, among others. In addition to examining very light jet forecasts, we spoke with aviation experts about the factors that they thought would most affect the number of very light jet deliveries over the next 10 to 20 years. The factor they mentioned most often was the growth of the air taxi market, although some believed the air taxi market could significantly increase the demand for very light jets while others believed that air taxi operations would not succeed on a large scale. We found that the eight forecasts we examined were based on limited information. For example, since very light jet manufacturers have just begun to produce new aircraft, there is little information on delivery trends for these aircraft. In addition, there was less consensus across the very light jet forecasts compared to other business jet forecasts, and past very light jet forecasts have failed to accurately predict when these aircraft would enter the NAS.

According to studies we reviewed and aviation experts we contacted, we found that there were various opinions about how increasing numbers of very light jets would affect capacity in the NAS, although most experts believed that very light jets would have little effect on safety. We examined two studies that found that the type and location of airports used by very light jet operators will influence the effect of these aircraft on NAS capacity. Experts we spoke with also indicated that the type of airports used by very light jet operators was important. For example, many experts believed that very light jets will travel to small airports that have excess runway capacity. However, a few experts believed that very light jets will travel to large airports and thus could affect NAS capacity by contributing to airline delays. In addition to airport type, experts indicated that the effect of very light jets on NAS capacity depends on other factors including the various uses of very light jets in the airspace, the trip length and altitude of very light jet flights, the implementation of new air traffic control technologies and equipment, the performance capabilities of very light jets, and the rate of integration of very light jets. Most experts we contacted believed that very light jets will likely have little overall effect on safety due to FAA's certification processes and procedures for aircraft, pilots, and maintenance, all of which apply to very light jets.

According to FAA, the agency currently has the policies and procedures in place to accommodate the entry of very light jets—which it believes will occur incrementally—into the NAS. These officials, and several other experts with whom we spoke, agreed that very light jets are similar to other aircraft currently in operation and do not require substantial changes to existing policies and procedures. However, FAA is taking additional steps to specifically address any unique issues surrounding the integration of very light jets as a precautionary measure to ensure that these aircraft are integrated smoothly. For example, FAA established a cross-organizational group to facilitate communication about very light jets across FAA departments. FAA officials stated that large numbers of very light jets may pose resource challenges, but the agency has plans in place to address this issue as needed. For example, according to officials, FAA is planning on redeploying resources and is having discussions with local FAA offices that are expecting to see increased demand for inspectors. In the long term, FAA expects that the deployment of new technologies, such as communications equipment that will enable pilots and controllers to have a common picture of airspace and traffic, will help integrate very light jets into the NAS. Because the aircraft will have advanced avionics, they will be able to take full advantage of new air traffic control technologies. Most experts we contacted expressed support for FAA's modernization activities as a way to maintain system capacity and safety for all aircraft, including very light jets, but encouraged FAA to work to rapidly deploy such technologies.

The effect of increasing numbers of very light jets on FAA's costs and Trust Fund revenues will depend on several factors in addition to the number of very light jets deployed, such as the extent to which they replace existing aircraft and whether they are operated for commercial or noncommercial purposes. There is uncertainty, however, about these factors that leads to uncertainty about the effect on costs and revenues. For example, one critical but largely speculative factor is the extent to which a market for air taxi services using very light jets will develop. If very light jets are used in air taxi operations it would add to FAA's costs, but also increase revenues, because the planes would have a higher rate of use than very light jets used in noncommercial operations. The administration has submitted a proposal for reauthorizing FAA that calls for a change in the current excise tax structure, and Congress is considering funding alternatives as well. However, due to the amount of uncertainty regarding the number and use of very light jets, there is too little information to accurately assess the revenue impacts under the various proposals.

We provided a draft of this report to the Department of Transportation for review and comment. The Department of Transportation provided technical clarifications, which we incorporated in the report as appropriate.

Background

FAA is responsible for regulating and promoting the safety of general aviation, including very light jets, by overseeing manufacturers and operators to require full compliance with safety regulations. General aviation includes all civil aircraft not flown by commercial carriers or the military.[1] To this end, FAA must certify any new aircraft design before that aircraft can be registered in the United States for private or commercial operations. When aircraft manufacturers request approval of a new aircraft type design, FAA uses the type certification process to ensure that the design complies with applicable requirements and airworthiness standards. FAA issues production certificates, which allow manufacturers to obtain an airworthiness certificate for duplicate aircraft produced under an FAA-approved type design. FAA also is responsible for establishing and enforcing standards for the certification of pilots and instructors as well as maintenance technicians and repair stations. FAA expects that most owner operators of very light jets will already have a pilot certification and the associated flight experience.

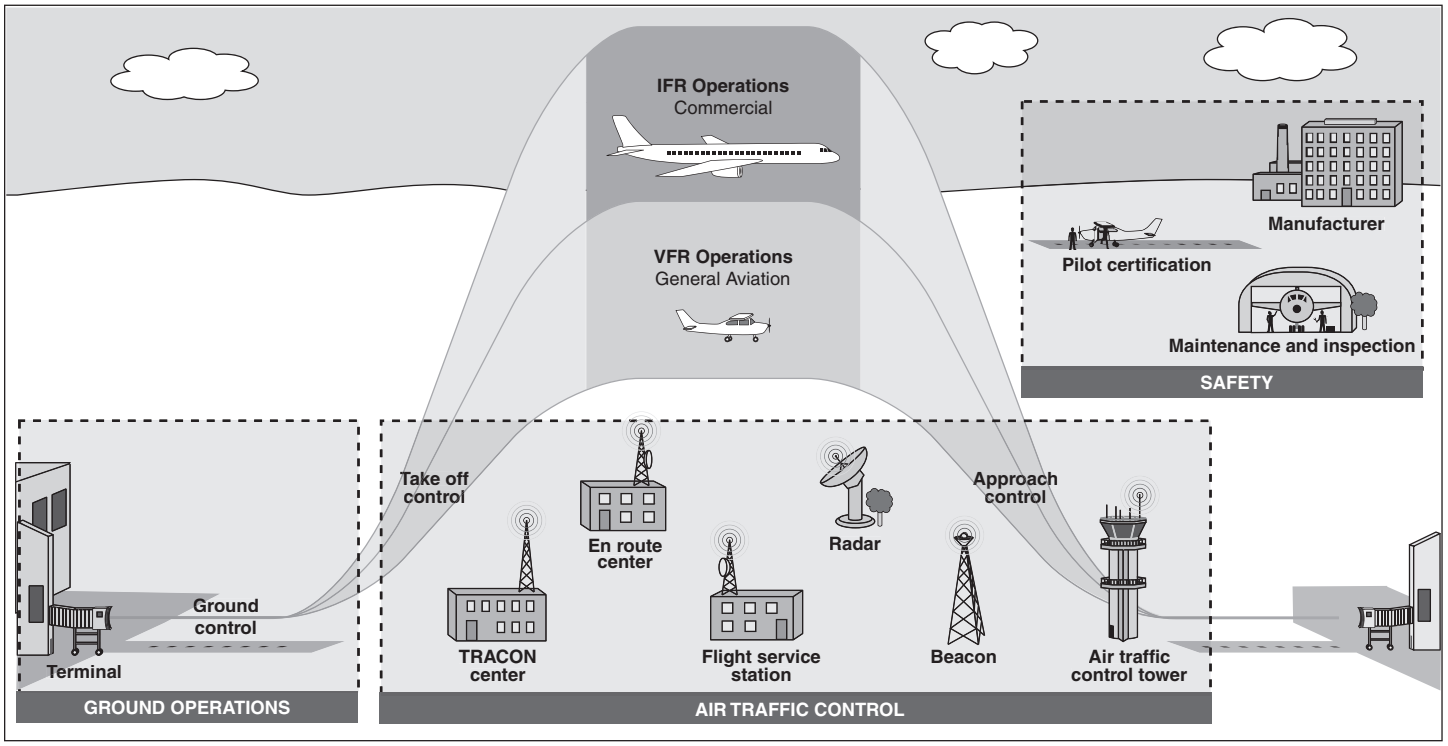
Another of FAA's primary functions is managing air traffic, which includes a variety of complex activities that guide and control the flow of aircraft through the NAS. Generally, commercial aircraft fly under instrument flight rules that require air traffic services, which are provided by FAA. Control towers guide these flights in the terminal and runway areas and through takeoffs and landings. Once in the air and beyond the immediate vicinity of the airport, aircraft rely on the terminal radar approach control centers to guide them out of the airspace surrounding the airport.[2] Then, the flight is passed to air route traffic control centers to provide en route control until they near their destinations. (See fig. 1.) Nearly all business jets and roughly half of general aviation piston engine flights fly under

[1]According to FAA, there is no standard definition for the term general aviation; its definition changes depending on, among other things, whether one is referring to safety statistics or user categories. In addition, for purposes of its recent cost allocation study, FAA included air taxis, which are sometimes considered general aviation aircraft, as commercial aircraft based on the taxes that are assessed to air taxi operators.

[2]Depending on the airport's location, the approach control facilities may be located within the airport's control tower or at separate facilities.

instrument flight rules and file flight plans that are used by air traffic control to reserve time and location in the NAS.[3] However, many general aviation flights operate entirely under visual flight rules and may not use air traffic control services at all if they fly from and to airports that do not have towers. Other general aviation flights operating under visual flight rules may require ground control and traffic advisories, which are provided by air traffic control towers, and other air traffic centers.

Figure 1: FAA Activities and Services



Source: GAO (data); Art Explosion (images).

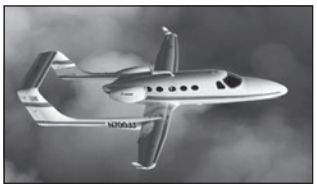
Very light jets are a new entrant into the U.S. airspace. Very light jet is a marketing term with no single definition, although most aviation experts describe these aircraft using a combination of the following elements: weight and price. Generally speaking, very light jets are jet aircraft with a

[3]Business jets are turbojet aircraft weighing less than 100,000 pounds maximum gross takeoff weight, with wingspans less than 100 feet that are used by companies to conduct their business.

maximum take-off weight of 10,000 pounds, certificated for single pilot operations, equipped with advanced avionic systems, and priced below other business jets.[4] By this definition, we identified nine proposed very light jet models as of July 2, 2007 (see figure 2). Two of these models—the Cessna Citation Mustang and Eclipse 500—have received FAA type and production certification and begun delivering aircraft.

[4]In 2006, the average price for a business jet aircraft was $18.71 million.

Figure 2: Proposed Very Light Jet Models as of July 2, 2007

Name of aircraft	Manufacturer	First flight	Type certification	Production certification	Maximum take-off weight	Seating	IFR range (nautical miles)	Price (in millions, 2006 dollars)
A700  Source: Adam Aircraft Industries.	Adam Aircraft	July 2003	Summer 2008 (estimated)	To be determined	8,500 lbs	6 to 8	1,100	$2.20
Citation Mustang  Source: Cessna Aircraft Company.	Cessna Aircraft Company	Apr. 2005	Sept. 2006	Nov. 2006	8,645 lbs	6	1,150	$2.54
D-JET  Source: Diamond Aircraft.	Diamond Aircraft Industries	Not reported	Mid-2008 (estimated)	Not reported	Not reported	5	1,350	$1.38
Eclipse 500  Source: (c) copyright, Eclipse Aviation Corporation; 2007.	Eclipse Aviation	Dec. 2004	Sept. 2006	Apr. 2007	5,995 lbs	5 to 6	1,300	$1.52

Name of aircraft	Manufacturer	First flight	Type certification	Production certification	Maximum take-off weight	Seating	IFR range (nautical miles)	Price (in millions, 2006 dollars)
Elite  Source: Epic Aircraft.	Epic Jet	June 2007	Fourth quarter 2009 (estimated)	Fourth quarter 2009 (estimated)	7,700 lbs	6 to 8	1,400	$2.35
Embraer Phenom 100  Source: Embraer	Embraer	Mid-2007 (estimated)	Mid-2008 (estimated)	Mid-2008 (estimated)	10,000 lbs	8	1,160	$2.92
HondaJet picture not available	Honda Aircraft Company	Not reported	First quarter 2010 (estimated)	Second to third quarter 2010 (estimated)	9,963 lbs	7 to 8	1,180	$3.65
Javelin MK-10/ MK-20  Source: Aviation Technology Group Inc.	Aviation Technology Group	Sept. 2005	Dec. 2009 (estimated)	Dec. 2009 (estimated)	7,200 lbs	2	1,000	$2.74 (scheduled to increase to $2.93 million sometime during 2007)
PiperJet picture not available	Piper Aircraft Inc.	First quarter 2008 (estimated)	2009 (estimated)	Mid-2010 (estimated)	To be determined	6 to 7	1,300	$2.199

Source: Very light jet manufacturers (data).

Note: We did not include a number of developmental very light jet aircraft in figure 2, such as the Cirrus Jet, the Excel-Jet Sport-Jet, and the Spectrum 33 jet because of the lack of sufficient performance and price information.

The aviation industry considers very light jets to be general aviation aircraft because of the way they will operate in the NAS. FAA divides general aviation activities into use categories, including: air taxi, business, corporate, instructional, personal, and other uses (see table 1). In addition, general aviation aircraft can be used in a fractional ownership arrangement, which is when a person or company buys or leases a fractional interest in one aircraft. Over the course of the lease, they can use that aircraft for a certain number of hours or days per year, as do the aircraft's other fractional owners. In 2005, the U.S. general aviation fleet

consisted of 224,352 active general aviation aircraft that flew about 27 million hours. Turbojets—a category of aircraft that will include very light jets—made up 4.3 percent or 9,823 of the total active general aviation fleet. The rest of the active aircraft included, among others, piston engine aircraft, turboprops, and rotorcraft.

Table 1: Use Categories of General Aviation

Use	Percentage of total general aviation flight hours in 2005	Description
Air taxi	10.6	On-demand passengers and all cargo operations
Business	12.0	Use of aircraft in connection with pilot's occupation or private business
Corporate	11.4	Use of aircraft owned or leased by a corporation or business and flown by a professional pilot
Instructional	13.5	Flying under the supervision of a flight instructor
Personal	34.3	Use of aircraft for pleasure or personal transportation and not for business purposes
Other uses	17.9	Examples include: Federal, state, or local government owned or leased aircraft used for a government function
Total[a]	**100**	

Source: FAA.

[a]The total was rounded to 100 percent.

Aviation Experts Identified Features That Make Airports Attractive to Air Taxi Operators

- Fixed base operators to provide fuel and other supplies to aircraft operators.
- Availability of ground transportation such as taxi cab operators and rental car companies.
- Close proximity to customer populations.
- Technology providing precise navigation and landing guidance.

It is expected that very light jets will be used in ways that are similar to other types of general aviation aircraft, such as in corporate fleets and as business or personal aircraft.[5] However, some companies also are planning to use very light jets as air taxis and air charters—operations providing on-demand, point-to-point flights. For example, an air taxi operator called DayJet is planning to use very light jets to offer per-seat on-demand flights on planes servicing selected airports in the southeastern United States. This is a departure from the traditional charter business model, which requires clients to charter the entire airplane for their flight, and sometimes pay for associated repositioning costs. In addition, at least one current air taxi company plans to sell individual seats on scheduled flights.[6]

Current Market Forecasts for Very Light Jets Vary Widely, Reflecting Differences in Assumptions and Limited Available Information

The eight very light jet forecasts we examined predicted a range of 3,016 to 7,649 in the number of very light jet deliveries as well as a range in the dates by which those numbers would be reached, from 2016 to 2025.[7] These forecasts were based on assumptions related to a number of factors that could affect the number of very light jet deliveries, especially regarding the success or failure of air taxi operations. Aviation experts also identified several factors that could affect overall deliveries, such as growth of the air taxi market, dissatisfaction with other forms of transportation, low purchase price and operating costs, access to airports, training and insurance requirements, and production constraints. Forecasts were primarily based on expert opinion and used the limited information available on the business markets for very light jets.

[5]In a previous report, GAO contacted the Department of Transportation and industry officials regarding the use of very light jets for serving small communities, especially in the near term. These officials noted that current very light jet business models indicate operators will provide premium point-to-point service between cities that are larger than the communities that participate in the Essential Air Service program. The Essential Air Service program was established by Congress as part of the Airline Deregulation Act of 1978 to help areas that face limited air service. See, GAO, *Commercial Aviation: Programs and Options for Providing Air Service to Small Communities*, GAO-07-793T (Washington, D.C.: Apr. 25, 2007).

[6]According to FAA, although current regulations do not allow very light jets to operate in scheduled service, FAA is in the process of proposing new rules to allow for the operation of these aircraft in scheduled service.

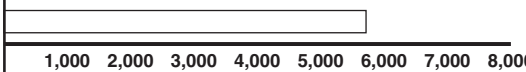
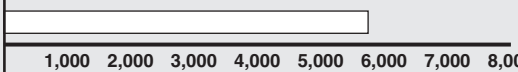
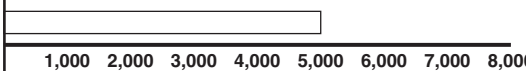
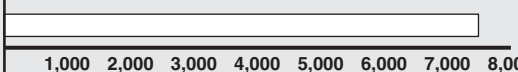
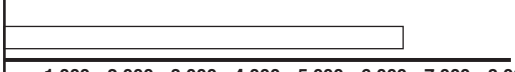
[7]Deliveries refers to the number of aircraft shipped and received, not the total number of aircraft in the NAS.

Very Light Jet Forecasts Estimated a Range of Very Light Jet Deliveries

The eight very light jet forecasts we examined predicted different numbers of very light jet deliveries—from 3,016 to 7,649—and different dates by which those numbers of aircraft would be reached, from 2016 to 2025 (see fig. 3).[8] Of the forecasts we examined, all except FAA and Velocity Group (an aviation consulting firm) forecasts included international deliveries of very light jets. Several forecasts predicted that most very light jet deliveries would go to customers in North America; one analyst noted that sales in the United States could represent around 70 percent of total deliveries. The definition of a very light jet differed somewhat across the forecasts. For example, some of the forecasts included predictions for single-engine very light jets, such as the proposed Diamond D-Jet, while other forecasts did not include single-engine aircraft. However, most of the forecasts included five new aircraft models that manufacturers have scheduled to enter service over the next several years: Adam A700, Cessna Citation Mustang, Eclipse 500, Embraer Phenom 100, and HondaJet.

[8]See appendix II for our selection criteria for the forecasts we examined.

Figure 3: Total Forecasted Number of Very Light Jets

Forecast organization (description)	Forecasted end year	Number of forecasted very light jet deliveries	Notes
Embraer (aircraft manufacturer)	**2016 (without air taxi demand)**		Embraer very light jet forecast without air taxi demand. Very light jets are defined as multi-engine turbojet aircraft weighing 10,000 pounds or less, such as Adams A700, Cessna Citation Mustang, Eclipse 500, and Embraer Phenom 100.
	2016 (with air taxi demand)		Embraer very light jet forecast with air taxi demand. Very light jets are defined as multi-engine turbojet aircraft weighing 10,000 pounds or less, such as Adams A700, Cessna Citation Mustang, Eclipse 500, and the Embraer Phenom 100.
Forecast International (aerospace consulting firm)	**2016**		Very light jets are defined as jet aircraft that typically seat up to eight people with list prices ranging from less than $1 million to approximately $2.85 million. They generally weigh 10,000 pounds or less and are certified for single-pilot operations. Aircraft included in the forecast are Adam A700, Cessna Citation Mustang, Eclipse 500, and Embraer Phenom 100.
Honeywell (manufacturer of aerospace products and services)	**2016**		The forecast includes personal jets (aircraft weighing less than 7,500 pounds and retailing for under $2.4 million) and several of the new generation low-cost aircraft carried in the very light jet segment. Aircraft included in the forecast are Adam A700, Beechcraft Premier I, Cessna Citation Mustang, Cessna Citation CJ1, Cessna Citation CJ2, Cirrus, Diamond D-Jet, Eclipse 500, Embraer Phenom 100, HondaJet, and Sino-Swearingen SJ30-2.
PMI Media (aerospace and defense publisher)	**2016**		Very light jets are defined as jet aircraft weighing 10,000 pounds or less, certificated for single pilot operations, and possessing some advanced avionics. Aircraft included in the forecast are Adam A700, Cessna Citation Mustang, Diamond D-Jet, Eclipse 500, Embraer Phenom 100, and HondaJet.
Teal Group (aerospace consulting firm)	**2016**		Very light jets are defined as small jets selling for $1-$4 million. Aircraft included are Cessna Citation Mustang, Embraer Phenom 100, HondaJet, and potentially one or two other players.
Velocity Group (aviation consulting and communications firm)	**2016** (with moderate growth in the air taxi industry)		Velocity Group very light jet forecast with moderate growth in the air taxi industry. Very light jets are defined as turbojet aircraft priced between $0.5 million and $4.0 million.
	2016 (with strong growth in the air taxi industry)		Velocity Group very light jet forecast with rapid growth in the air taxi industry. Very light jets are defined as turbojet aircraft priced between $0.5 million and $4.0 million.
FAA (federal agency)	**2020**		Very light jets are defined as jet aircraft weighing 10,000 pounds or less, certificated for single pilot operations, and possessing some advanced avionics. Very light jets entering service soon include Adam A700, Cessna Citation Mustang, Eclipse 500 and Embraer Phenom 100. The forecast predicts deliveries to U.S., not international, customers.
Rolls-Royce (aerospace power systems and service provider)	**2025**		Aircraft included in the forecast are the Adam A700, Cessna Citation Mustang, Eclipse 500, Embraer Phenom 100, and Embraer Phenom 300.

Source: GAO analysis of very light jet forecasts.

Almost all of the very light jet forecasts we examined were based on expert opinion regarding business markets for very light jets and analyses of proposed aircraft models. For example, one of the main sources of information for developing the FAA forecast was an October 2006 aviation expert workshop jointly hosted by the Transportation Research Board and FAA. Forecasters also relied heavily on projected economic trends and variables, such as expected growth in the gross domestic product and corporate profits.[9] One of the very light jet forecasts surveyed corporate flight departments and general aviation operators about their purchase expectations.

Very Light Jet Forecasts' Assumptions Vary, Especially Regarding the Air Taxi Market

The forecasts we examined considered a number of factors that might affect the number of very light jet deliveries, including the development of the air taxi market, economic growth, production constraints, insurance and training requirements, and expected aircraft retirements, to name a few. The forecasts made several assumptions regarding these factors as shown in table 2.

[9]According to the Commerce Department's Bureau of Economic Analysis, gross domestic product is the market value of goods and services produced by labor and property in a country, regardless of nationality.

Table 2: Summary of Assumptions Influencing Very Light Jet Forecasts

Forecast organization	Assumptions on which very light jet forecasts are based
Embraer	• Increasing corporate profits, S&P growth rates, world gross national product, and U.S. interest rates • No serious/major/significant terrorist incidents or worldwide pandemics • Successful development of air taxi operations • New aircraft models • Aging business jet fleet • Growth in fractional ownership
Forecast International	• Continuing economic growth and rising corporate profits • No new user fees • Long term success of air taxi operations dependent on surpassing regulatory obstacles and airport access issues • New aircraft models lead to increased purchases • Increased demand for new aircraft because of low number of used business jets available • The reputations of established manufacturers potentially providing an advantage over startup companies • Insurance and training considerations
Honeywell	• Purchase expectations of corporate flight departments and general aviation owner/operators • No unforeseen events, such as war, major economic shock, fuel crisis, or new regulatory restrictions • Moderate economic growth with modest cyclical perturbations • New aircraft models lead to increased purchases • Demand from emerging air taxi operations is not factored into the estimates and would be considered additive to overall demand should the air taxi business model prove widely viable
PMI Media Limited	• Moderate economic growth with a slowdown in 2010-2012, followed by a recovery • Air traffic congestion fears are unfounded • Air taxi operators will consolidate and eventually evolve into fractional ownership operations • Advantage of manufacturers familiar with the certification process with other aircraft • Time to develop high volume production as the supply chain ramps up
The Teal Group Corporation	• High corporate profits, high commodity prices, and growth in emerging markets • Organic growth in the number of corporate flight departments • A large number of aircraft retirements are expected • Established manufacturers having an edge over newcomers • The air taxi market will not succeed, except on a small scale • Very light jets serving as replacement aircraft for high-end turboprops • Extensive training, insurance, and financing as barriers to entry

Forecast organization	Assumptions on which very light jet forecasts are based
Velocity Group	• Air taxi operations capturing a percentage of high yield customers (i.e., domestic airline travel at full fare coach, business class or first class) • Higher demand for air taxi service in communities with poor commercial service • The timing of demand growth, the expected utilization of aircraft, and passenger load forecasts • Very light jets capturing twenty percent of the total turbine market sold in the $0.5 to $4 million price category for use in private, charter, and fractional operations
Federal Aviation Administration	• Moderate economic growth • No major geopolitical events • Sufficient infrastructure to handle projected levels of activity and keep pace with demand • Sufficient growth in the on-demand air taxi market to absorb a majority of projected very light jet deliveries • Production on pace with predicted demand • The aircraft perform as advertised
Rolls-Royce	• Infrastructure on pace with growth • Strong future macro economic growth with rising corporate and personal wealth • New aircraft models lead to increased deliveries • A large number of aircraft retirements are expected • Markets outside the U.S. are ramping up • No substantive air taxi network • Demand for very light jets resulting from a shift from turboprops

Source: GAO analysis of very light jet forecasts.

Each of the eight forecasts we reviewed included assumptions about the effect of economic growth and the expansion of the air taxi market. The forecasts all assumed moderate to strong economic growth, while assumptions regarding the air taxi market varied considerably. For example, the Teal Group forecast predicted the air taxi market would not expand on a large scale. However, several other forecasts included predictions of several thousand very light jet deliveries to air taxi operators. For example, Embraer forecasted that the air taxi market might be responsible for 2,500 to 3,000 very light jet deliveries by 2016 if there is demand for air taxi services.

In addition, very light jet forecasts included assumptions regarding other factors:

- *Replacement market.* Customers may purchase very light jets to upgrade from existing aircraft, which could affect the number of very light jet deliveries. There is also an expectation that a large number of aircraft will be retired in the future, which could create further demand for very light jets to replace aging aircraft.

- *Large number of aircraft models.* The large number of very light jet models gives customers more options to choose from and might strengthen demand. For example, Rolls-Royce notes that there tends to be a high correlation between total aircraft deliveries and the number of models on the market.

In addition to the information gathered from the forecasts, we asked 18 aviation experts from the federal government, academia, aviation equipment manufacturers, industry associations, air taxi operators, and aviation insurance companies to identify factors they thought would most impact the number of very light jet deliveries over the next 10 to 20 years.[10] The factor mentioned most often was the growth in the air taxi market, which could significantly affect very light jet demand if successful. However, several experts did not think air taxi operations will succeed on a large scale and noted that the on-demand business model is nothing new. They argued that if the point-to-point on-demand air taxi business model were so attractive, it could have become popular already using similar existing business jets and propeller aircraft.

The 18 experts also identified several other factors that they thought might influence very light jet demand, including:

- *Dissatisfaction with other forms of transportation.* Increased hassle associated with commercial airline and automobile travel may lead to higher demand for very light jets.

- *Low purchase price and operating costs.* The relatively low costs of acquiring and operating very light jets may lead to increased demand.

- *Access to airports with the appropriate infrastructure.* According to aircraft manufacturers, very light jets will be able to use a relatively large number of private and public airports, which could help increase demand. However, infrastructure needs, such as hangar space and availability of ground transportation, may limit access to these airports and thus limit demand for very light jets. Difficulty accessing metropolitan airports, which are already congested, might also limit demand for these aircraft.

[10]The aviation experts we interviewed were not selected randomly, and their views and opinions cannot be generalized to the larger population of experts and aviation officials. (See app. I for a discussion of scope and methodology.)

- *Training and insurance requirements*. The time and money needed to achieve the necessary levels of training and insurance could become burdensome to potential pilots and limit demand to some extent.

- *Production constraints.* The ability of aircraft manufacturers to produce enough very light jets to meet demand may influence the number of aircraft delivered.

Limited Information Is Available for Forecasting Very Light Jet Deliveries

The very light jet forecasts we reviewed were primarily from the forecasters' own expert opinions about potential markets and business models, but the forecasters had limited information on which to make their predictions about very light jet deliveries. For example, since very light jet manufacturers have just begun delivering the new aircraft, there is little information about product demand. Forecasters indicated that they based their assumptions about very light jet demand on information about past deliveries for other aircraft in comparable price classes, such as light jets and turboprop airplanes; however, these aircraft do not have exactly the same performance characteristics as very light jets. For example, several forecasts examined the markets for turboprop aircraft and predicted the proportion of customers who might instead purchase new very light jets.

In addition, forecasts were based on limited information regarding the air taxi market. There is an ongoing debate about the extent to which the availability of very light jets will facilitate an expansion of the air taxi market. Some aviation experts stated that very light jets will reduce acquisition and operating costs compared with other business jets, which will enable a number of variations on current on-demand air taxi and air charter business models. However, the first delivery to an air taxi company took place at the end of March 2007. Without past market information, it is difficult to predict the overall effect of air taxi operations on the number of very light jet deliveries.

We compared very light jet forecasts to more general business jet forecasts and found that there was less consensus among forecasters about the expected number of very light jet deliveries than there was about other aircraft deliveries, which demonstrates the divergence of opinion about very light jet deliveries. Specifically, four of the eight organizations with very light jet forecasts that we examined also produced

overall business jet forecasts for the years 2015 to 2016.[11] The range in the predicted number of very light jet deliveries for these four forecasts is from 3,016 to 5,715 aircraft, an approximately 47 percent difference. However, the range in predicted number of other business jet deliveries for the forecasts was much closer, from 7,000 to 8,984 aircraft, only an approximately 22 percent difference.[12]

We also examined four past very light jet forecasts and found that they did not accurately predict very light jet deliveries. For example, in February 2006, FAA predicted 100 very light jets would enter the active air fleet during fiscal year 2006, but manufacturers did not deliver any very light jets during the fiscal year. The other three forecasts also overestimated the number of very light jet deliveries for 2006. In addition, in 2002, the Transportation Research Board and FAA sponsored an aviation expert workshop, which suggested up to 5,000 very light jets may arrive by the year 2010. Yet none of the eight current very light jet forecasts that we examined predict 5,000 deliveries over the next 3 years.

[11]The Rolls-Royce forecast predicts very light jet and overall business jet demand in 2025 and was considered an outlier for the purposes of this illustration.

[12]Percent differences were calculated by subtracting the lowest number in the range from the highest number and then dividing the result by the highest number of the range.

Studies and Expert Opinions Varied on How Very Light Jets Will Affect Capacity, but Most Experts Believe Very Light Jets Will Have Little Effect on Safety

Two studies we reviewed and 20 experts we contacted had various opinions regarding how very light jets will affect NAS capacity; the experts believed that very light jets would have little effect on safety.[13] The studies indicated that the effect of very light jets on capacity will be determined to some extent by the type and location of airport they use. Many experts believed very light jets will travel to small airports, such as reliever and general aviation airports, and will have little effect on the capacity and safety of the NAS.[14] A few experts believed very light jets will travel to large airports, such as hub airports, and have a significant effect on capacity through increased air traffic operations. In addition to airport type, experts indicated the effect of very light jets on the NAS depends on other factors including: uses of very light jets entering the NAS, trip length and flight altitude, implementation of new air traffic control technologies and equipment, and aircraft performance capabilities. Most of the experts we contacted indicated that very light jets will likely have little overall effect on safety.

Studies and Experts Identified Factors That Would Influence Very Light Jets' Effect on Capacity

The two studies we reviewed—one by the National Aeronautics and Space Administration (NASA) and one by the Massachusetts Institute of Technology (MIT)—indicated that the type and location of airports used by very light jets will influence very light jets' effect on capacity.[15] However, the studies differed in results because of, among other things, differing assumptions. The NASA study assumed that very light jets would not travel to hub airports because of the cost and congestion involved in flying to these airports.[16] The NASA study found that very light jets used for air taxi operations could increase commercial delays for the year 2025

[13]The aviation experts we interviewed were not selected randomly and their views and opinions cannot be generalized to the larger population of experts and aviation officials. (See app. I for more information.)

[14]Reliever airports are airports that must have 100 or more based aircraft or 25,000 annual itinerant operations, and that provide operators such as general aviation aircraft an alternative to using hub airports. General aviation airports are airports not classified as commercial service.

[15]National Aeronautics and Space Administration, *The Effects of Very Light Jet Air Taxi Operations on Commercial Air Traffic*, NASA/CR-2006-214519 (Hampton, Virginia; October 2006); and Massachusetts Institute of Technology, *Investigation of the Potential Impacts of the Entry of Very Light Jets in the National Airspace System* (Cambridge, Massachusetts; Oct. 30, 2006).

[16]A hub airport is a primary airport that has 0.05 percent or more of all annual U.S. enplanements.

by an estimated 1.3 percent if very light jets do not use hub airports. The NASA study also looked at a scenario in which very light jets are not excluded from hub airports that have significant general aviation traffic today, although the study concluded that this was an unlikely scenario. NASA concluded that, under such a scenario, the increase in total delay for commercial passenger flights could be as much as 9.8 percent. The MIT study predicted that very light jets used as air taxi services, fractional ownership programs, recreational flights, and freight carriers will have a significant effect on air traffic growth at high activity airports including hubs located within metropolitan areas. The study concluded that some of these airports will ultimately reach their capacity limit. The MIT study assumed that very light jets' performance and capabilities would be similar to the performance of light jets and found that very light jets would operate at the top regional airport systems that currently exhibit high density and capacity constraints. MIT also found that very light jets will not significantly affect airports outside of metropolitan areas because these airports have excess runway capacity to handle additional aircraft. The study indicated that very light jets will increase controllers' workload because of very light jets' lower climb performance and cruise speed compared to other jets in the en route environment. As a result, the study noted that air traffic controllers will need to separate very light jets from faster traffic in high density routes between large cities such as New York City and Chicago, which could increase delays.

In addition to the studies, we also spoke with experts from federal agencies, industry associations, academia, and others who indicated that the extent of very light jets' effect on capacity depends on numerous factors. Similar to the NASA and MIT studies, the experts believed that the type of airport at which very light jets would operate was a key factor influencing the effect on capacity. Many experts we spoke with believed that very light jets would operate at reliever and general aviation airports, where they could have little effect on capacity because of excess runway capacity at these airports. However, a few of these experts noted that even though very light jets may not operate at hub airports, their use of secondary airports near major metropolitan airports could affect capacity by increasing commercial delays. Other experts believed that very light jets would operate at hub airports with significant airline traffic, which could negatively affect capacity by causing airline delays.

The experts we contacted also identified other factors influencing very light jets' effect on capacity, including the following:

- *Uses of very light jets in the airspace.* The various ways that very light jets might operate in the NAS, such as an air taxi or recreational aircraft, will help to determine the extent of their effects on capacity. Very light jets operating as air taxis will likely have a greater effect on capacity as opposed to other users because of a higher utilization rate in the NAS.[17] In FAA's 2007 forecast, the agency assumed that very light jets operating as air taxis will average 1,500 hours per year, fractional owners 1,200 per year, and recreational use 350 hours per year.[18] Very light jets operating as recreational aircraft would likely have less effect on capacity due to lower utilization rates and operating at general aviation airports with excess runway capacity.

- *Trip length and altitude of very light jet flights.* Very light jets might operate shorter flights and travel at lower altitudes than commercial planes and have little effect on capacity. If many very light jets fly at higher altitudes and longer distances, they could have a greater effect on capacity, resulting in delays and congestion.

- *Implementation of new air traffic control technologies and equipment.* Very light jets likely will be equipped with new technologies and equipment, such as Automatic Dependent Surveillance-Broadcast (ADS-B) that, once deployed by airports nationwide, would help to increase capacity by providing position, intent, velocity, and other information between aircraft and ground systems to manage air traffic.

- *Performance capabilities of very light jets.* Very light jets have slower climb rates and cruising speeds than commercial airlines, which could influence their effect on capacity when mixing with other aircraft in the terminal and en route environments. FAA and several experts, including experts representing active air traffic controllers, believe that very light jets will increase the complexity of the airspace due to their performance capabilities. FAA indicated that controllers will segregate very light jet traffic from airline traffic if they travel in the same airspace.

- *Rate of integration of very light jets.* FAA officials told us that they do not expect very light jets to significantly affect capacity in the next 5 to 6 years because of the incremental integration of very light jets into the airspace.

[17]Utilization rate is the average number of hours an aircraft is flown per year. Some references cite revenue hours as opposed to total hours.

[18]Federal Aviation Administration, *FAA Aerospace Forecasts Fiscal Years 2007-2020* (Washington, D.C.; March 2007).

FAA assumes that 400 to 500 very light jets will enter the NAS annually starting in 2008.

Very Light Jets Will Likely Have Little Effect on Safety, According to Experts

The experts we contacted believed very light jets will likely have little overall effect on safety due to FAA's certification processes and procedures for aircraft, pilots, and maintenance and the advanced technology used to navigate the aircraft. In addition, several experts stated that very light jets do not cause safety concerns because they will operate like existing aircraft in the airspace. However, FAA and some experts noted that very light jets could introduce safety concerns such as recreational pilots' lack of experience flying jets. To address these concerns, FAA and the aviation industry have established guidelines for developing pilot training programs for very light jets and a voluntary scenario-based training to enhance general aviation safety. Aviation insurance companies, along with very light jet manufacturers, are working together to institute a proficiency index to assess pilots' experience and training needs and develop programs such as mentor pilot training for new pilots of very light jets.[19]

FAA Officials Believe Procedures and Policies Are in Place to Accommodate Very Light Jets, but FAA Is Taking Steps to Prepare for Their Introduction

FAA officials stated that procedures and policies are in place to successfully integrate very light jets into the NAS because very light jets will operate similarly to other aircraft and will enter incrementally. Nonetheless, FAA is taking several steps to address issues associated with very light jets, including the development of a cross-organizational group to facilitate coordination, as well as collaborating with air taxi operators and providing information to air traffic controllers. FAA officials and aviation experts also believe very light jets will benefit from new technologies and procedures being developed as part of FAA's modernization efforts.

[19]The mentor pilot training is used to, among other things, observe a pilot's handling of aircraft and use of automation and provide feedback to the pilot.

FAA Officials Stated They Have Procedures and Policies in Place to Handle the Introduction of Very Light Jets

According to FAA officials, existing aviation standards and regulations are adequate to successfully integrate very light jets into the NAS. These officials and several other experts agreed that very light jets are similar to other aircraft currently in operation and do not require substantial changes to existing procedures and policies. For example, very light jets are required to meet aircraft certification standards set out in Federal Aviation Regulations Part 21 and 23.[20] These regulations set out certification procedures and airworthiness standards for aircraft weighing less than 12,500 pounds and will be applied to new very light jets, according to FAA officials. FAA also stated that, as part of the certification process, it will meet with manufacturers to outline "special conditions," which are specific requirements developed for those aircraft seen by FAA as using novel or unique technologies. The two very light jet models currently operating in the NAS—the Eclipse 500 and the Cessna Citation Mustang—were required to pass these certification and airworthiness standards, including special conditions. In addition to aircraft certification requirements, FAA is responsible for establishing and enforcing standards for the certification of pilots and instructors as well as maintenance technicians and repair stations. These standards are based on the complexity and classification of the aircraft and type of operation.[21]

Although there may eventually be thousands of very light jets in the NAS, FAA stated that these aircraft are expected to enter incrementally, which will allow for their gradual integration into the NAS. Several forecasters and FAA are predicting fewer than 400 very light jets will be delivered in 2007. FAA officials also noted that very light jets are currently entering the NAS at a slower rate than many previously predicted.

FAA Is Taking Steps to Prepare for the Introduction of Very Light Jets

Although FAA officials believe they have policies and procedures in place to accommodate the integration of very light jets into the NAS, FAA is taking several steps to specifically address issues arising from an increased number of very light jets. According to one FAA official, the agency is taking these steps as a precautionary measure to ensure that

[20]14 C.F.R. §§ 21 and 23. Part 21 is Certification Procedures for Products and Parts. Part 23 is Airworthiness Standards: Normal, Utility, Acrobatic, and Commuter Category Airplanes.

[21]FAA inspectors with oversight responsibilities for more complex aircraft and types of operation must meet higher minimum qualifications, including additional training and experience. For example, standards are higher for an aircraft requiring a type rating. In addition, operations in which passengers are carried for hire are more stringently regulated than flights solely for personal use. Private pilots may not carry passengers for hire.

very light jets are integrated smoothly. For example, in July 2005, FAA developed a cross-organizational group to identify and address issues regarding very light jets related to the following: pilot training and checking, inspector training, flight operations, maintenance, and air traffic. The cross-organizational group includes approximately 35 representatives from numerous lines of business and service organizations within FAA, such as the Air Traffic Organization—responsible for moving air traffic safely and efficiently—and Flight Standards Service—responsible for setting certification standards and oversight of pilots, aircraft operators, and designees. According to one FAA official, the cross-organizational group was formed to communicate ideas across FAA departments, as a way to avoid coordination problems. FAA officials also stated that the cross-organizational group has developed inspector training for several of the new very light jets, conducted briefings to air traffic controllers on very light jet performance characteristics, and is working with manufacturers and air taxi operators on an ongoing basis.

Aside from the cross-organizational group, FAA is conducting several other activities including:

- Continuing to work with an industry association to bring air taxi operations into the collaborative decision making process.[22]
- Continuing to make air traffic control centers aware of any unique very light jet operational requirements through bulletins, briefings, and traffic management courses.
- Establishing a very light jet computer simulation model for use during qualification and annual refresher training for air traffic controllers.
- Planning to conduct operational test flights with DayJet to observe a very light jet as it works through the airspace environments.
- Conducting a wake turbulence study to examine potential impacts of turbulence generated by large aircraft on very light jets.

[22]Collaborative decision making is a joint government/industry initiative aimed at improving air traffic management through increased information exchange among the various parties in the aviation community. The collaborative decision making program is made up of representatives from government, general aviation, airlines, private industry, and academia who are working together to create technological and procedural solutions to traffic flow problems that face the NAS.

- Funding research on the potential effect of very light jets on U.S. airports, including an examination of future operations by category of airport, geographic location, and type of operation, as well as potential infrastructure, facilities, and services that particular airports will need to accommodate future very light jet activity.

FAA stated that a large influx of very light jets might necessitate the reallocation of inspector resources. FAA is aware of this challenge and has developed an Aviation Safety Workforce Plan. FAA is planning on redeploying resources to meet demand as needed, according to the official we contacted. Discussions are ongoing with the local Flight Standard District Offices where FAA is expecting to see increased demand for inspectors, such as in Albuquerque, New Mexico, where Eclipse Aviation is based. FAA officials also stated they have developed a course to train maintenance and avionics inspectors at these locations. However, GAO noted in 2006 that very light jets could create workload challenges for FAA inspectors to expeditiously issue and monitor certificates.[23] In addition, aviation experts have raised concerns about the number of FAA inspectors. For example, in a May 2007 testimony, the Inspector General of the Department of Transportation reported that 28 percent of FAA's inspector workforce is eligible to retire this year and that FAA will face oversight challenges as large numbers of very light jets begin to operate in the NAS. Other aviation experts with whom we spoke also expressed concern over certification delays arising from limited FAA inspector resources. According to FAA, the number of safety inspectors increased between fiscal year 2005 and fiscal year 2006 and the agency plans to continue to increase its inspector workforce through fiscal year 2008.

FAA Officials Believe That NAS Modernization Will Accommodate Very Light Jet Demand for FAA Services

FAA stated that NAS modernization efforts and new technologies will improve efficiency and safety for all aircraft, including very light jets. FAA and other government agencies are developing the Next Generation Air Transportation System (NextGen), which is intended to provide services to what is expected to be two to three times more air traffic in 2025 compared with today, while being agile enough to accommodate a

[23]See GAO, *Aviation Safety: FAA's Safety Efforts Generally Strong but Face Challenges*, GAO-06-1091T (Washington, D.C.: Sept. 20, 2006).

changing fleet that includes very light jets.[24] According to the FAA, NAS modernization will reduce congestion, assist with separation standards, and increase overall system capacity. Aviation experts and very light jet manufacturers we spoke with stated that very light jets have advanced avionics and are expected to be able to take full advantage of NextGen systems.

Eleven of the 14 aviation experts we spoke with regarding FAA's plans to integrate very light jets into the NAS noted that FAA needs to continue to adopt and implement new technologies to maintain system capacity. Experts stated that the current air traffic control system is antiquated and cannot be scaled up to meet projected increases in air traffic. Experts encouraged FAA to adopt and implement NextGen technologies, such as ADS-B, at a rapid pace to maintain current system capacity. FAA and aviation experts also pointed to the importance of continuing to develop more precise routes through Area Navigation and Required Navigation Performance procedures, which, according to FAA, may increase system capacity and safety by enabling closer aircraft spacing with less intervention from air traffic control.

Several Factors Will Influence the Effect of Very Light Jets on FAA's Costs and Trust Fund Revenues

The effect of very light jets on FAA's costs to provide air traffic control services[25] and on Trust Fund revenues will depend on several factors in addition to the number of very light jets deployed, such as the extent to which they replace existing aircraft and how their use is distributed between commercial and noncommercial operations. One critical but particularly speculative factor likely to affect FAA's costs and revenues is the extent to which a market for air taxi service using very light jets will develop. Both the administration and Congress have proposed changes in the current funding structure for FAA for fiscal year 2009, which, if adopted, would affect how very light jet operators are taxed.

[24]GAO has reported that the NAS is expected to accommodate a variety of new aircraft, such as the jumbo Airbus A380, which can hold more than 500 passengers. See GAO, *Commercial Aviation: Potential Safety and Capacity Issues Associated with the Introduction of the New A380 Aircraft*, GAO-07-483 (Washington, D.C.: Apr. 20, 2007).

[25]FAA incurs costs for other services it provides, such as aircraft maintenance or certification, but we have limited our examination of the effect on FAA's costs to those costs associated with the provision of air traffic control services.

Several Factors Will Influence the Effect of Very Light Jets on FAA's Costs

A number of factors will determine the effect on FAA's costs of introducing very light jets into the NAS. Several of these factors suggest that FAA's costs might increase, although the extent of any increase is uncertain at this time. Factors include what type of aircraft, if any, very light jets will replace; the type of operations for which very light jets will primarily be flown; and where and when very light jets are flown. However, there is enough uncertainty about these factors to make the overall effect on costs unclear. For example, if flights using very light jets replace flights using other high-performance aircraft (such as another business jet or turboprop aircraft) on a one for one basis, there may be little or no net effect on FAA's costs because they would be replacing flights that, according to FAA, impose similar costs on the air traffic control system.[26] However, there are at least three scenarios where FAA's costs would rise with the introduction of very light jets. First, if very light jet flights replace flights made with piston engine aircraft—again on a one for one basis—FAA's costs may increase because, according to FAA, controlling a high-performance aircraft such as a very light jet generally requires more complex air traffic equipment and procedures than needed to control a piston engine aircraft. These additional requirements arise because of differences in flight characteristics between the types of aircraft. For example, jets are more likely than piston engine aircraft to be flown under instrument flight rules at a higher altitude. Second, because of the smaller number of passengers that can be carried on very light jets, these flights could replace other high-performance flights on a more than one for one basis. In such cases, FAA's costs could rise as it would have to control more flights to carry the same number of passengers. Third, flights by very light jets that would be new flights not previously made (e.g., a business traveler who used to drive to a meeting 200 miles away and begins using an air taxi service or a small corporation that purchases a very light jet as its first corporate plane) will require services from FAA's

[26]In January 2007, FAA released a new cost allocation study. This report sets forth a methodology for assigning air traffic costs to user groups on the basis of aircraft type. The two principal user groups are the high-performance group, which includes all fixed-wing turbine engine aircraft operations, and the piston engine aircraft group, which includes piston engine fixed-wing aircraft operations and helicopters. According to FAA, this cost allocation methodology is based on the assumption that high-performance users generally compete for the same air traffic control resources and their operations are more time-sensitive than piston aircraft operations, requiring more complex air traffic equipment and procedures. Piston aircraft operations, on the other hand, tend to be less time-sensitive and typically rely on less complex equipment. Differences in speed and cruising altitudes of the two aircraft types also affect their en route costs. Federal Aviation Administration, *FY2005 Cost Allocation Report* (Washington, D.C.; Jan. 31, 2007).

air traffic control system that had not been required previously, increasing costs for FAA.

The type of operations for which very light jets are flown—noncommercial or commercial—will also be a factor that will affect FAA's costs. If current trends hold, very light jets used in noncommercial service (e.g., corporate jets) would have a lower utilization rate—approximately 300 hours per year for each corporate aircraft according to FAA's 2005 data—and cost FAA around the same as current jet aircraft used in noncommercial operations. Very light jets used for commercial operations (e.g., air taxis) would entail higher costs because of the higher utilization rates. It is unclear at this point in time, however, what percentage of very light jets will be used for commercial operations and what will be the utilization rates for air taxi operators. In 2005, according to FAA data, air taxi operators used each aircraft on average 413 hours per year. But some air taxi operators are anticipating that that they will fly a very light jet up to 1,500 revenue hours per year—substantially more than current commercial air taxi operators. Such use of very light jets could significantly affect FAA's costs.

Another factor that will affect FAA's costs is the extent to which very light jets will compete for resources currently provided to other aircraft. That is, very light jets might impose more costs if they are used more frequently where and when there is substantial congestion in terminal airspace. If they are most commonly used at less congested airports or at less busy times of the day, then the additional costs to FAA might be less, even if their use leads to a total increase in the number of flights.

Several Factors Will Influence the Effect of Very Light Jets on Trust Fund Revenues

Several factors about which there is uncertainty—including some of the same ones that will impact FAA's costs—would influence the effect of very light jets on Trust Fund revenues. These factors include the distribution of flights between commercial and noncommercial operations, whether the flights replace existing flights on a one to one basis or represent additional flights, and whether there is a rapid expansion of the air taxi market.

FAA currently is funded from two sources: the Trust Fund and the General Fund.[27] The Trust Fund collects revenues from a series of aviation-related excise taxes, including taxes on airfares and fuel. The distribution of very light jet flights between commercial and noncommercial operations would affect Trust Fund revenues because very light jet operators would be responsible for different excise taxes depending on the purpose of the flight. Commercial operators, such as air taxi and charter operators, pay passenger ticket taxes, passenger segment taxes, and fuel taxes. Noncommercial business, corporate, and personal users pay only fuel taxes, but the fuel tax rate is higher than for commercial operations (see table 3). Very light jets used for commercial purposes could provide more revenue to the Trust Fund than those used for business or corporate use. The overall effect on revenues depends on miles traveled, number of passengers, fares charged, and other factors that are uncertain at this time.

Table 3: Estimated Excise Tax Contribution for a Very Light Jet by Type of Flight

Approximately 300-mile flight from Tallahassee to Boca Raton		
	Air taxi service (commercial use)	**Corporate trip (noncommercial use)**
Number of passengers	2	2
Average fare per passenger	$900	[a]
Gallons of fuel used	100	100
Passenger ticket tax[b]	$135	[a]
Passenger segment tax[c]	$6.80	[a]
Fuel tax[d]	$4.30	$21.80
Total tax revenue	**$146.10**	**$21.80**

Source: GAO analysis of FAA and industry data.

[a]Not applicable.

[b]The passenger ticket tax is 7.5 percent of the ticket price.

[c]The passenger segment tax is $3.40 per passenger segment during calendar year 2007. Each segment consists of one takeoff and landing.

[d]The commercial fuel tax is $0.043 per gallon and the noncommercial jet fuel tax is $0.218 per gallon.

[27]The General Fund historically has been used to pay for portions of FAA's budget, with contributions towards the agency's overall budget averaging about 20 percent in recent years.

In cases where the very light jet is purchased as a replacement aircraft, the effect on the Trust Fund's revenues depends on the use of the aircraft they are replacing. If the very light jet is used in a similar manner to the aircraft it replaces, there may be little to no net change in revenue. If the very light jet is used for a purpose different from the aircraft it is replacing, there could be more or less revenue depending on comparative uses. Very light jets that provide additional flights rather than replace flights made by existing aircraft will provide additional excise tax revenue.

Successful expansion of the air taxi market would affect the Trust Fund's revenues because some operators predict substantial increases in aircraft utilization rates. As discussed above, some commercial operators predict that very light jets used in commercial air taxi operations would be flown more frequently than in current air taxi operations thereby generating relatively more fuel and passenger ticket tax revenue. A couple of aviation experts suggested that successful air taxi operations may attract new passengers who currently travel by automobile, potentially leading to increased demand for commercial flights and additional revenue. However, experts suggested that successful air taxi operations could reduce revenue from traditional commercial airlines if they encourage first class passengers to travel by air taxi instead. At this time, however, the implication for Trust Fund revenue is unclear because the air taxi model has yet to prove itself. According to FAA officials, it will be at least 10 years before there is an observable decrease in the number of commercial airline flights because of passengers transferring to air taxi operations, though effects on revenue could appear earlier.

Reauthorization Proposals Call for Changes to Funding Structure

In February 2007, the administration submitted a proposal for reauthorizing FAA and the excise taxes that fund most of its budget, which called for a mix of user fees and fuel taxes for the purpose of providing a more stable and cost-based funding structure. Congress is considering alternatives to the administration's proposal. For example, the Senate Commerce, Science, and Transportation Committee has reported out legislation that would retain the existing excise taxes but add a modernization surcharge of $25 that would be imposed on most jet aircraft flights, with some exceptions.[28] The House Transportation and

[28]S.1300, 110th Cong., 1st Sess. § 106 (May 3, 2007). Exceptions to the $25 surcharge include, among others, military and public aircraft, air ambulances, piston engine aircraft, and turboprop aircraft operating outside of controlled airspace.

Infrastructure Committee has reported out its own version of the FAA reauthorization bill, H.R. 2881, which also does not impose user fees as the administration recommended.[29] A recommendation from the House Committee on Transportation and Infrastructure to the House Committee on Ways and Means to increase the tax rates for general aviation jet fuel and aviation gasoline would increase Trust Fund revenues. As with the current funding structure, there is too much uncertainty about very light jets to accurately compare the revenue effects of these proposed alternative funding structures, other than to note that the factors discussed in the previous section would continue to affect revenues.

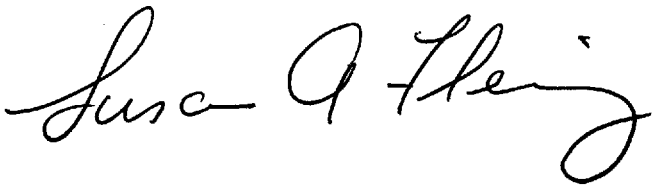
Agency Comments

We provided a draft of this report to the Department of Transportation for review. We received comments and technical clarifications by e-mail from FAA's Office of the Associate Administrator for Airports, Office of the Associate Administrator for Aviation Safety, and Air Traffic Organization, which we incorporated into the report as appropriate.

We are sending copies of this report to the appropriate congressional committees, the Secretary of Transportation, and the FAA Administrator. We also will make copies available to others upon request. In addition, the report will be available at no charge on the GAO Web site at http://www.gao.gov.

[29]H.R.2881, 110th Cong., 1st Sess. (June 27, 2007).

If you or your staff have any questions about this report, please contact me at (202) 512-2834 or flemings@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix II.



Susan Fleming
Director, Physical Infrastructure Issues

Appendix I: Objectives, Scope, and Methodology

We examined (1) the current forecasts for very light jet deliveries and the factors that contribute to the differences among the forecasts, (2) the potential effect very light jets may have on capacity and safety of the National Airspace System (NAS), (3) the Federal Aviation Administration's (FAA) plans for accommodating the entry of very light jets into the NAS, and (4) the potential effect very light jets may have on FAA's costs and Airport and Airway Trust Fund (Trust Fund) revenues.

To identify current forecasts for very light jet production, we conducted a literature review of government, aviation industry, and academic publications and interviewed aviation industry experts, FAA officials, and academic experts. From these sources, we compiled a list of publicly and commercially available forecasts. We contacted the entities that produced the forecasts and obtained information about their forecasts. We developed criteria for selecting forecasts to include in our review. The forecasts we selected had to be published within the past 12 months and estimate the number of aircraft for a specific timeframe. We did not include five predictions for very light jet deliveries because they did not include a timeframe or were demand models that provided multiple very light jet estimates based on a number of inputs. For example, Eclipse Aviation, a very light jet manufacturer, had a prediction for potentially higher very light jet deliveries (8,995 annually) than any of the forecasts included in our analysis. This forecast, however, emphasized very light jet demand once the market hits maturity, but, since it did not indicate when that might happen, we did not include it in our review. We also did not include several dynamic growth models, which are capable of producing very light jet demand estimates for air taxi operations based on a number of changing inputs. Based on our criteria, we selected eight forecasts to include in our review, which were produced by FAA, the Teal Group, Honeywell, Rolls-Royce, Forecast International, PMI Media Limited, Embraer, and Velocity Group. We reviewed these forecasts and determined that they were sufficiently reliable for our purposes. We developed a data collection instrument to collect information from each of the forecasts (e.g., projected number of very lights, forecast date, underlying assumptions, factors affecting growth, etc.) and examined this information to identify similarities and differences among the forecasts. From this comparison, we identified the factors and assumptions affecting the total number of very light jet deliveries discussed most often. In order to obtain additional information about the factors that would affect the number of very light jets delivered, we contacted selected organizations and individuals with expertise in general and business aviation, including

- federal government officials (FAA's Office of Aviation Policy and Plans, FAA's Flights Standards Service, National Aeronautics and Space Administration),
- academic researchers (Virginia Polytechnic Institute and State University, Massachusetts Institute of Technology, George Mason University),
- an air taxi service company (DayJet),
- aircraft equipment manufacturers (Adam Aircraft, Eclipse Aviation, Pratt & Whitney),
- aviation insurance companies (Global Aerospace, AIG Aviation),
- an air traffic manager of a general aviation airport (Chicago Executive Airport),
- an aviation consulting firm (Boyd Group), and
- industry associations (American Association of Airport Executives, Aircraft Owners and Pilots Association, Air Transport Association, General Aviation Manufacturers Association, National Business Aviation Association).

We developed the list of organizations to contact by interviewing experts from FAA and general aviation associations and asking for the names of other experts knowledgeable about issues affecting general and business aviation and about factors affecting very light jet production.

To determine how increasing numbers of very light jets could affect the capacity and safety of the NAS, we reviewed government, academic, and aviation industry studies that described how very light jets might operate in the future and their potential effects on FAA's air traffic management system. We reviewed GAO reports and FAA regulations in order to obtain information about how FAA regulates general aviation aircraft safety and manages aircraft operations. We developed the list of organizations to contact by interviewing experts from FAA and general aviation associations and asking for the names of other experts who are knowledgeable about how general aviation aircraft currently operate and how very light jets could operate in the future. To obtain information about these issues, we contacted

- federal government officials (FAA, National Transportation Safety Board, National Aeronautics and Space Administration),

- academic researchers (Virginia Polytechnic Institute and State University, Massachusetts Institute of Technology, George Mason University),
- an air taxi service company (DayJet),
- aircraft equipment manufacturers (Cessna Aircraft Company, Adam Aircraft, Eclipse Aviation),
- aviation insurance companies (Global Aerospace, AIG Aviation),
- air traffic managers of general aviation airports (Chicago Executive Airport, Boca Raton Airport), and
- industry associations (American Association of Airport Executives, Aircraft Owners and Pilots Association, Air Transport Association, General Aviation Manufacturers Association, National Business Aviation Association, National Air Traffic Controllers Association).

We also asked the aforementioned agencies and organizations to identify factors that could influence the effect of very light jets on capacity and safety. We analyzed the responses and summarized the findings. Based on suggestions from these experts, we reviewed two studies conducted by the National Aeronautics and Space Administration and the Massachusetts Institute of Technology evaluating the effect of very light jets on the NAS and determined that they were sufficiently reliable for our purposes.

To determine how FAA is planning to accommodate potential very light jet demand, we met with FAA officials from the Air Traffic Organization, Office of Aviation Policy and Plans, Flight Standards Service, and the very light jet cross organizational group to discuss FAA's current procedures for handling new aircraft and plans for additional action. We also discussed with FAA's Air Traffic Organization the agency's plans for transforming the air traffic control system to the Next Generation Air Transportation System (NextGen) and how this relates to the future entry of very light jet aircraft into the NAS. We reviewed GAO and FAA reports describing plans for implementing NextGen policies and technologies. To obtain information about what FAA should be doing to prepare for very light jets, we contacted selected organizations and individuals with expertise in general and business aviation, including

- federal government officials (National Aeronautics and Space Administration),

- academic researchers (Virginia Polytechnic Institute and State University, Massachusetts Institute of Technology, George Mason University),
- an air taxi service company (DayJet),
- aircraft equipment manufacturers (Adam Aircraft, Eclipse Aviation),
- aviation insurance companies (Global Aerospace, AIG Aviation),
- an air traffic manager of a general aviation airport (Chicago Executive Airport), and
- industry associations (American Association of Airport Executives, Aircraft Owners and Pilots Association, Air Transport Association, General Aviation Manufacturers Association, National Business Aviation Association).

To determine the potential effect of very light jets on FAA's costs and revenues, we met with FAA officials from the Office of Aviation Policy and Plans to discuss FAA's allocation of costs and the excise taxes that fund the Airport and Airway Trust Fund. We also discussed the administration's reauthorization proposal and how the proposed excise taxes could affect general aviation users. We reviewed the Senate and House reauthorization proposals for information about how they could affect general aviation users. We reviewed GAO and FAA reports for information about FAA's costs, excise taxes, and revenues. We interviewed aviation excise tax experts from the Internal Revenue Service to determine which excise taxes apply to different general aviation users.

We conducted our work between September 2006 and July 2007 in accordance with generally accepted government auditing standards.

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

Susan Fleming, (202) 512-2834 or flemings@gao.gov

Staff Acknowledgments

In addition to the contact named above, key contributors to this report were Gerald Dillingham, Hal Brumm, Jay Cherlow, Matt Cook, Seth Dykes, Colin Fallon, Dave Hooper, Gail Marnik, Sara Ann Moessbauer, Faye Morrison, and Joshua Ormond.

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