### **Commercial Space**

The FAA's Office of Commercial Space Transportation (AST) licenses and regulates U.S. commercial space launch activities including launch and reentry of vehicles and operation of non-federal launch and reentry sites authorized by Executive Order 12465 and Title 51 U.S. Code, Subtitle V, Chapter 509 (formerly the Commercial Space Launch Act). Title 51 and the Executive Order also direct the U.S. Department of Transportation to encourage, facilitate, and promote U.S. commercial launches. The FAA's mission is to license and regulate commercial launch and reentry operations and non-federal launch sites to protect public health and safety, the safety of property, and the national security and foreign policy interests of the United States.

The FAA licenses launches or reentries carried out inside the U.S. and by U.S. persons (which includes U.S. corporations) inside or outside the United States. The FAA does not license launches or reentries the U.S. Government carries out for the Government (such as those owned and operated by National Aeronautics and Space Administration (NASA) or the Department of Defense). Amateur-class rockets do not require a FAA license or permit<sup>10</sup>.

To accomplish its mission, the FAA performs the following major functions:

 Maintains an effective regulatory framework for commercial space transportation activities,

- Provides guidance to prospective commercial operators on how to comply with regulatory requirements for obtaining an authorization and operating safely,
- Evaluates applications for licenses, experimental permits, and safety element approvals for launch and reentry operations and related commercial space transportation activities,
- Evaluates applications for licenses for launch and reentry site operations,
- Monitors and enforces regulatory compliance through safety inspections of launches, reentries, sites, and other regulated commercial space activities,
- Provides U.S. Government oversight of investigations associated with the mishap of an FAA authorized launch or reentry,
- Facilitates the integration of commercial space launch and reentry operations into other modes of transportation including the National Airspace System (NAS) by establishing appropriate hazard areas and limits to ensure the protection of the public,
- Coordinates research into the safety and operational implications of new technologies and the evolving commercial space transportation industry,
- Conducts outreach to the commercial space industry by hosting working groups and conferences,
- Collaborates with Government partners, such as the Department of Defense and

(200,000 pound-seconds) or less; and cannot reach an altitude greater than 150 kilometers above the earth's surface.

<sup>&</sup>lt;sup>10</sup> Per 14 CFR Chapter 1, Part 1, section 1.1: Amateur rocket means an unmanned rocket that is propelled by a motor or motors having a combined total impulse of 889,600 Newton-seconds

NASA to assure consistent approaches to regulations, policy, and standards, and

• Conducts outreach to international counterparts to promote the U.S. regulatory framework across the world.

In addition to AST headquarters offices in Washington, D.C., AST maintains staff with assigned duty locations near active launch ranges to facilitate communication with space launch operators and to implement FAA's regulatory responsibilities more efficiently. AST personnel are currently assigned to duty locations near Kennedy FAA Regulatory Safety Oversight Activities

FAA supports commercial space oversight and operations throughout the regulatory process. There are many activities performed by FAA during this process. The most notable activities are described here.

#### Pre-Application Consultation for Licenses, Experimental Permits, and Safety Element Approvals

Prospective applicants seeking commercial space transportation licenses, experimental permits, or safety element approvals are required by regulation to consult with FAA before submitting their applications. During this period, FAA assists them in identifying potential obstacles to authorization issuance and determining potential approaches to regulatory compliance. In addition, many new operators are seeking to incorporate new technologies, vehicle types, or operational models creating opportunities for FAA to assist in determining the applicable regulations or approach to regulatory compliance.

# Licenses, Permits, and Safety Element Approvals

FAA authorizes commercial space transportation activities via the issuance of licenses, Space Center and Cape Canaveral Space Force Station in Florida; Johnson Space Center in Texas; Wallops Flight Facility in Virginia; FAA's Western-Pacific Regional Office; Vandenberg Space Force Base, and the Mojave Air and Space Port in California. FAA also directly supports NASA's commercial space initiatives by providing on-site staff at both the Johnson Space Center and Kennedy Space Center to coordinate the FAA's regulatory and compliance activities with NASA's development and operational requirements for commercial space.

permits, and safety element approval. Typically, FAA issues a license with a narrow scope to a single vehicle configuration and mission trajectory. With the dynamic commercial space industry, these licenses are required to be modified to add additional vehicle configurations and mission profiles. FAA's new regulatory regime under Part 450 intends to allow flexibility by allowing authorization to conduct launch or reentry activities for various vehicle configurations and trajectories from multiple sites.

Within safety and oversight is the requirement to conduct both policy and payload reviews. When conducting a policy review, FAA determines whether the proposed launch, reentry, or site operation presents any issues that would adversely affect U.S. national security or foreign policy interests or be inconsistent with international obligations of the United States. If not otherwise exempt from review, FAA reviews a payload proposed for launch or reentry to determine whether the payload would jeopardize public health and safety, the safety of property, U.S. national security or foreign policy interests, or the international obligations of the United States. The policy and/or payload determination becomes part of the licensing record on which FAA's licensing determination is based.

FAA issues launch and reentry site operator licenses and license renewals. FAA coordinates with Federal, state, and local governments and with the commercial range operators or users for commercial space licenses and operations. As part of the evaluation of applications for launch licenses, reentry licenses, and site operator licenses, FAA also conducts environmental reviews consistent with its responsibilities under the National Environmental Policy Act.

FAA anticipates issuing a growing number of safety element approvals for space launch systems equipment, processes, technicians, training, and other supporting activities. FAA reviews, evaluates, and issues safety approvals to support the continued introduction of new safety systems, safety operations applications, and safety element approval renewal applications.

#### Safety Analyses

FAA conducts flight safety, system safety, maximum probable loss, and explosive safety analyses to support the evaluation and issuance of licenses and permits. FAA also evaluates and analyzes the performance of a vehicle operator's safety systems including safety-critical systems and any associated crew involved in the function of the safety system to determine how they affect public safety risk.

#### **Inspections and Enforcement**

FAA currently conducts as many as 750 preflight/reentry, flight/reentry, and postflight/reentry safety inspections per year. Inspections often occur simultaneously at any of the 14 licensed commercial space launch

sites, as well as at 4 Federal launch ranges and 3 exclusive use launch sites. The establishment of non-federal launch sites requires additional inspections in areas such as ground safety that have traditionally been overseen by the U.S. Air Force (now the U.S. Space Force) at Federal ranges. At spaceports and launch sites with high launch rates (e.g., Cape Canaveral Space Force Station, Kennedy Space Center, and Vandenberg Air Force Base), at least 70 percent of inspections are typically conducted by locally based field inspectors. Currently, the FAA intends to leverage a risk-based approach to respond to a dynamic operational tempo, minimize cost, and increase efficiency.

#### Mishap Investigations

Mishap events have demonstrated that FAA needs to have the capacity to oversee the investigation of at least two space launch or reentry mishaps or accidents simultaneously anywhere in the world, and to lead/oversee as many as nine investigations during a single year. FAA anticipates an increase in mishaps with new operators coming online. FAA reviews all applicant mishap plans and accident investigation procedures as part of the license and permit evaluation process.

#### NAS Integration

AST works in partnership with all FAA linesof-business, notably the Air Traffic Organization (ATO) and Office of Airports (ARP), to support the safe and efficient integration of commercial launch and reentry operations through the NAS and its system of airports and air traffic managed by the ATO. Further, AST works with the ATO and the Office of NextGen (ANG) as FAA develops technologies to facilitate safe and efficient integration of commercial launch and reentry operations through the NAS, including technologies to improve the integration of launch and reentry data into FAA air traffic control systems and

#### FY 2024 Results

Between 1989 and 2024, FAA licensed 824 launch/reentries. Most of this activity occurred in the last five years (2020-2024). During this period, 432 launches and reentries occurred, accounting for over 56 percent of the total. In FY 2024, launch and reentry operations totaled 148, the highest posted in U.S. history, and 17 percent of all activity since 1989.

A vast majority of the licensed launches (130 out of 142) occurred at three U.S. sites and one international site. The top U.S. launch sites included Cape Canaveral, Florida (61 launches), Vandenburg Space Force Base (SFB), California (41 launches), and Kennedy Space Center, Florida (17 launches). Eleven U.S. licensed launches occurred at Mahia, New Zealand. The remaining 12 licensed launches occurred at five different sites.<sup>11</sup>



<sup>&</sup>lt;sup>11</sup> Boca Chica, Texas; Van Horn, Texas; Mid-Atlantic Regional Spaceport, Virginia; Mojave Air & Space Port, California; Spaceport America, New Mexico

technologies to improve the timely and accurate development and distribution of notices of aircraft hazard areas.

Correspondingly, the 142 launches were conducted by six operators, with SpaceX accounting for 83 percent of the total (118 launches). The remaining 17 percent were conducted by Rocket Lab (12 launches), Virgin Galactic (4 launches), Blue Origin (3 launches), United Launch Alliance (2 launches), Firefly Aerospace (2 launches), and Stratolaunch (1 launch).



The total number of licensed reentries in FY2024 was six. Four reentries were in the Gulf of America, one reentry was in the Atlantic Ocean, and one occurred at the Utah Test and Training Range. Five of the six reentries were conducted by SpaceX, with the remaining reentry conducted by Varda.

The launches covered a variety of missions, including the first-ever privately funded spacewalk by non-government astronauts.<sup>12</sup> Other missions included (but were not limited to) space tourism, satellite deployment,

one mission were exposed to the vacuum of space at the same time. Source: https://www.inc.com/kit-eaton/the-commercialspace-race-took-flight-in-2024/91070229.

<sup>&</sup>lt;sup>12</sup> The excursion represented the first use of a privately-created space suit designed for space-walks, and was the first time four people from

global emissions tracking of methane, and earth observation. Future missions are anticipated to also include cislunar operations, space travel to Mars, and in-orbit services.

#### Forecast

The starting point for FAA's launch and reentry operations forecast relies on data collected from operators and prospective applicants, tying launch and reentry activity directly to anticipated operations by commercial space transportation firms known to FAA. The forecasts are presented as a low case scenario and a high case scenario to provide a range of future activity, reflecting uncertainty at the pace of which launches and reentries will occur. All FAA-authorized commercial space operations are included in this forecast, regardless of where they occur.

In previous years, the commercial space operations forecast covered a five-year horizon. This year marks the first time the forecast spans a ten-year horizon. The expanded timeframe, along with the high case scenario and a low case scenario, is intended to better aid government and industry planners.

### *Increase in Operations Over Previous Projections*

In the high case scenario, FAA forecasts 4,010 authorized space operations over the ten-year forecast horizon – going from 183 operations in FY2025 to 566 operations in

In FY2024, ten licensed operations resulted in a mishap (eight during CY2024).

FY2034. In the low case scenario, FAA forecasts 2,067 authorized space operations -going from 174 operations in FY2025 to 259 operations in FY2034. The increase in operations reflects demand for activities such as in-orbit servicing, assembly, and manufacturing (ISAM); cislunar operations; Mars exploration; satellite deployment and replacement; and space tourism.<sup>13</sup>

A comparison of scenarios between the current forecast and the previously released forecast for the period FY2025-28 shows an overall increase of 65 operations for the high case scenario.<sup>14</sup> Similarly, a comparison of the low case scenarios shows an overall increase of 68 operations.

The following graph shows FAA's low and high case forecasts, as well as historical activity. FAA is forecasting launch and reentry activity to increase from a range of 174 to 183 in FY2025 to a range of 259 to 566 in FY2034.<sup>15</sup>

<sup>&</sup>lt;sup>13</sup> ISAM (In-orbit servicing, assembly, and manufacturing) is an emerging field within the aerospace industry that involves the use of robotic technology to perform tasks in space, such as repairing and maintaining satellites. Cislunar operations are those that would extend up to the Moon's orbit and may include commercial activities such as resource mining, placing satellites to enhance global communications networks, and

providing lunar habitats as a base for scientific research and tourism.

<sup>&</sup>lt;sup>14</sup> Prior forecasts of FAA authorized space operations were presented on a five-year basis.

<sup>&</sup>lt;sup>15</sup> This forecast does not include launch activity not authorized by the FAA (e.g., launches the Government carries out for the Government) or launch activity for other nations.



#### **Factors Affecting Forecast Accuracy**

The commercial space transportation industry is rapidly evolving. The industry's growth through technological innovation and the development of new markets increases the challenges associated with forecasting commercial space transportation operations

There are several factors that magnify the challenges with predicting the number of launches and reentries expected in any given year. These factors include:

- a dynamic list of firms that launch or intend to launch,
- development of new technologies,
- launch rates for reusable launch vehicles,
- commercial spaceflight by both government astronauts and private citizens,
- the dynamic nature of flight test programs,

- loosening or tightening of the regulatory environment, and
- mishaps.<sup>16</sup>

#### Satellite Deployment

Many of the missions included in the launch forecasts are affiliated with initial satellite deployment and their eventual replacement as they reach end of useful life. The timing for the deployment of satellites can affect forecast accuracy, especially in the latter years. In the near-term, forecast accuracy can be impacted by cancellation of satellite constellations. For example, last year's forecast included the launch of Boeing's V-Band constellation. Boeing surrendered their license for this constellation in September 2023, stating that surrendering their license was a

<sup>&</sup>lt;sup>16</sup> New technologies [e.g., reusable launch vehicles] allow a faster operational tempo, and at the same time, early use of these technologies can in-

crease the probability of a mishap. The time between mishap investigations and subsequent "return to flight" for impacted entities can take months, drastically impacting launch plans.

business decision regarding spectrum allocation.<sup>17</sup>

The current forecast for satellite deployment in the near term includes (but is not limited to), Amazon's Kuiper and SpaceX's Starlink. Deployment of Amazon's Kuiper is expected to begin in 2025 with 100 percent deployment by 2031, also marking the year that satellite replenishment begins. Starlink's LEO is expected to be 100 percent deployed by the end of 2025, with satellite replenishment beginning the same year.

## Changes to the List of Firms Intending to Launch

There is potential for launch service providers that have not been included in this forecast to emerge and begin conducting launches. Conversely, there is also the risk that a current launch service provider, or even multiple providers, may drop out of the market.

The list of firms intending to launch is dynamic, with smaller launch providers struggling in an increasingly competitive market. New arrivals to the industry face steep barriers to entry, including high development costs and intense competition from their established counterparts that provide reliable, frequent, and more cost-effective services.

At the start of 2024, there were 12 launch service providers in the U.S. During the year, ABL Space Systems withdrew from the commercial launch business to focus on missile defense.<sup>18</sup> In the previous year (2023), Virgin Orbit filed for bankruptcy protection. It ceased operations and sold its assets and equipment to other aerospace companies. Other market changes could occur in the future.

#### Move to Larger Launch Vehicles

Several rocket manufacturers are developing larger launch vehicles. SpaceX is continuing development of its 398-foot rocket, Starship. Starship's first launch occurred in April 2023. Blue Origin's 320-foot New Glenn rocket successfully launched to orbit during its first test flight in January 2025, although the goal of recovering the reusable booster stage during re-entry was not achieved. Relativity Space is developing Terran R, a 216-foot rocket. The Terran R is not expected to be launched until 2026, at the earliest.

Larger launch vehicles possess several key attributes that will enable operators to lower costs on a per launch basis. A brief description of these attributes as they pertain to Starship, New Glenn, and Terran R are provided below.

<u>Increased Payload Mass</u>: Terran R, New Glenn, and Starship will be able to launch payloads of up to 20, 45, and 150 metric tons, respectively, to low earth orbit.<sup>19</sup> For comparison purposes, the Atlas V, classified as a medium to heavy-lift launch vehicle, can carry a payload of 18.9 metric tons to low earth orbit.<sup>20</sup>

<u>Increased Payload Volume:</u> The larger launch vehicles will allow for heftier, more

<sup>&</sup>lt;sup>17</sup> Source: <u>Boeing Relinquishes License For LEO</u> <u>Broadband Constellation | Aviation Week Net-</u> <u>work</u>

<sup>&</sup>lt;sup>18</sup> Source: <u>ABL Space exits commercial launch</u> <u>market, shifts focus to missile defense - Space</u> <u>News</u>

<sup>&</sup>lt;sup>19</sup> Sources: <u>https://tlpnetwork.com/news/amer-ica/relativity-space-update-terran-r-preparing-for-first-flight; https://www.blueorigin.com/new-glenn; https://www.spacex.com/vehicles/star-ship/</u>

<sup>&</sup>lt;sup>20</sup> Source: https://en.wikipedia.org/wiki/Atlas\_V

complex cargo, such as satellites, spacecraft, telescopes, and supplies in a single mission.

<u>Reusability of Launch Vehicles:</u> Starship is a fully reusable launch vehicle that is expected to launch 100 times before retirement.<sup>21</sup> New Glenn is designed with a reusable first stage and a partially reusable second stage. New Glenn is expected to conduct multiple missions prior to retirement. The Terran R will have a fully reusable first stage and a second stage that will be discarded after use. Initially Terran R will be designed for 20 reuses.<sup>22</sup>

<u>Increased Launch Frequency:</u> By 2026, Starship is expected to be capable of 25 launches per year. Once fully operational, New Glenn is expected to be capable of 24 launches per year.

### *New Markets for Commercial Space Transportation*

In a shift away from past space domination by governmental agencies such as NASA and the Soviet Union's space program, private companies are increasingly interested in accessing the commercial space market.<sup>23</sup> Spurring optimism is the development of commercial space transportation technologies. Space data, products, and services provide tangible benefits and economic opportunities to people worldwide.<sup>24</sup> The demand for space activities such as exploration, tourism, cislunar operations, placement of satellites, and in-orbit servicing, assembly, and manufacturing (ISAM), are expected to grow with each successful mission. Subsequently, launch providers are motivated towards technology that will allow for launches to occur at an increased pace.

In the report *Space: The \$1.8 Trillion Opportunity for Global Economic Growth,* it is estimated the space economy will be worth between \$1.4 trillion and \$2.3 trillion by 2035, up from \$630 billion in 2023.<sup>25</sup> The main drivers for this growth include:

1) a decrease in launch costs, which have fallen 10-fold over the last 20 years.

2) commercial innovation, which has led to the use of smaller satellites that can provide higher resolution pictures at a lower cost.

3) diversification of investment and applications, with private sector investment reaching all-time highs and space-enabled activities, such as tourism, becoming mainstream.

4) cultural awareness and enthusiasm, as evidenced by government and business leaders increasingly consider what space could enable in the future.

<sup>&</sup>lt;sup>21</sup> Sources: Source: https://giz-

modo.com/spacex-sets-ambitious-goal-25-starship-flights-in-2025-2000524527

<sup>22</sup> Source: https://www.relativ-

ityspace.com/press-release/2023/4/12/terran-r <sup>23</sup> Source: <u>The Future of Space: Economic Op-</u> <u>portunities and Challenges | New Space Econ-</u> <u>omy</u>

<sup>&</sup>lt;sup>24</sup> Deployment of SpaceX's Starlink at little to no charge for users allowed for communication and internet services critical for residents and emer-

gency responders impacted by Hurricane Helene, Hurricane Milton and the Los Angeles wildfires. <u>https://www.ntd.com/free-starlink-servicecoming-to-los-angeles-areas-hit-by-wildfires-</u> musk-says 1039603.html.

<sup>&</sup>lt;sup>25</sup> Report published by the World Economic Forum in knowledge partnership with McKinsey & Company. Source: <u>https://www.mckinsey.com/industries/aerospace-and-defense/our-in-</u> <u>sights/space-the-1-point-8-trillion-dollar-oppor-</u> tunity-for-global-economic-growth