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Space Exploration

Overview

The National Aeronautics and Space Administration (NASA) is the primary federal agency for civil space programs. The National Oceanographic and Atmospheric Administration (NOAA) and the U.S. Geological Survey (USGS) also operate civil satellites. The U.S. commercial space industry provides equipment and services to both the government and the private sector. Several federal agencies have regulatory and other roles in commercial space.

NASA

With a budget of \$19.3 billion in FY2016, NASA develops and operates both manned and unmanned spacecraft. It also has programs in aeronautics research and education.

Legislation in the 113th and 114th Congresses

In the 113th Congress, committees in both chambers developed NASA reauthorization bills. The House bill (H.R. 4412) passed the House in June 2014. The Senate bill (S. 1317) was reported by the Committee on Commerce, Science, and Transportation in December 2014 but did not receive floor action. The most contentious issue for both bills was the authorization of appropriations, but both also contained numerous policy provisions about the scope, direction, and management of individual NASA programs. In the 114th Congress, the House has passed H.R. 810, and the House Committee on Science, Space, and Technology has ordered H.R. 2039 to be reported. Both bills are similar to H.R. 4412.

The first session of the 114th Congress enacted appropriations legislation to fund NASA in FY2016. As usual, committee reports accompanying the House and Senate bills, as well as the explanatory statement accompanying the final omnibus bill (P.L. 114-113), gave substantial programmatic guidance to NASA as well as directing the allocation of funds. The second session is considering appropriations for FY2017. The President submitted his FY2017 budget on February 9, 2016. The House Committee on Appropriations has reported H.R. 5393. The Senate Committee on Appropriations has reported S. 2837.

The U.S. Commercial Space Launch Competitiveness Act (P.L. 114-90), enacted in November 2015, addressed certain NASA human spaceflight programs, as well the federal regulation and oversight of commercial spaceflight and the legal regime for commercial asteroid mining.

Human Spaceflight

NASA's current efforts in human spaceflight include operation of the International Space Station (ISS), support for the commercial development of U.S. spacecraft to take astronauts to and from the ISS, and development of spacecraft for future human exploration beyond Earth orbit.

International Space Station. The ISS, which orbits Earth at an altitude of 200 to 250 miles, is composed of crew living space, laboratories, remote manipulator systems, solar arrays to generate electricity, and other elements. Crews have occupied the ISS on four- to six-month rotations since November 2000. The U.S. Commercial Space Launch Competitiveness Act extended the authority for continued U.S. use of the ISS through at least 2024.

To encourage more widespread use of the ISS for research, the NASA Authorization Act of 2005 (P.L. 109-155) designated the U.S. portion of the ISS as a national laboratory. As directed by subsequent legislation, NASA has contracted with the nonprofit Center for the Advancement of Science in Space (CASIS) to manage the ISS national laboratory function. ISS research utilization and the nature of ISS research continue to be of congressional interest.

NASA used to rely on the space shuttle to carry crews and cargo to and from the ISS. The space shuttle fleet was retired after the final flight of *Atlantis* in July 2011. Since then, ISS cargo has been carried by Russian, European, and Japanese spacecraft, and more recently, by two U.S. commercial providers—Space Exploration Technologies (SpaceX) and Orbital Sciences—under contract to NASA. In January 2016, NASA selected Sierra Nevada Corporation as a third commercial provider for ISS cargo transport. Since the end of the space shuttle program, ISS crews, including U.S. astronauts, have been carried exclusively by Russian *Soyuz* spacecraft.

Commercial Crew. NASA is funding two U.S. companies—Boeing and SpaceX—to develop a commercial capability to transport astronauts to and from the ISS and potentially other destinations in Earth orbit. The target date for the first crewed flight to the ISS is in 2017. Advocates argue that using commercial providers will reduce NASA's costs through competition and encourage development of a new commercial industry. Skeptics anticipate few non-NASA customers, doubt that the market can support more than one provider, and express concerns about astronaut safety. Congress and the Administration have often disagreed about the funding needs of the commercial crew program relative to NASA's development efforts for exploration beyond Earth orbit.

Orion and the Space Launch System. As directed by the NASA Authorization Act of 2010 (P.L. 111-267), NASA is developing new spacecraft for future human missions beyond Earth orbit. These are the crew capsule Orion and a new rocket, known as the Space Launch System (SLS), to carry Orion into space. A first (unmanned) test flight of Orion, using an existing rocket, took place in December 2014. The first test flight of Orion on an SLS, again without

a crew, is planned for 2018. The first test flight with a crew is expected in 2023.

Mars is widely agreed to be the long-term destination for human exploration of space. A mission to Mars, however, would require substantial additional development, so Orion and SLS are expected to visit other destinations first. NASA has proposed directing a large boulder from the surface of an asteroid into orbit around the Moon, where it could be visited by astronauts on an early Orion/SLS mission. This proposal has met with some skepticism in Congress. Other possible destinations include the Moon itself, an asteroid or comet in its original orbit, and a Mars fly-by or orbit.

Science

NASA's science program consists largely of unmanned spacecraft such as the Hubble Space Telescope and the Mars rover *Curiosity*. The program also conducts some research from aircraft. There are four main research areas: planetary science, Earth science, astrophysics, and heliophysics. In addition, NASA's Science Mission Directorate acquires and launches satellites on behalf of other agencies, such as NOAA.

Planetary Science. Three NASA planetary science probes have recently reached their destinations. *Dawn* arrived at the asteroid Ceres in March 2015, and *New Horizons* encountered Pluto in July 2015. These were the first two spacecraft to study dwarf planets at close range. In July 2016, *Juno* entered orbit around Jupiter for a mission scheduled to last through February 2018.

Earth Science. NASA funding for Earth science has risen from a low of \$1.2 billion in FY2007 to about \$1.9 billion in FY2016. Recent congressional debates over NASA science funding have often balanced support for Earth science against support for planetary science. Climate research is a major element of NASA's Earth science program. As a result, congressional attitudes toward the program often align with positions on climate change.

James Webb Space Telescope. In NASA's astrophysics program, the James Webb Space Telescope (JWST) is intended to be a successor to Hubble. Following a series of schedule delays and cost overruns between 2005 and 2010, NASA developed a revised plan for the JWST in 2011. In 2012, Congress capped the telescope's formulation and development costs and mandated annual reports on the program by the Government Accountability Office. The fourth such report, in December 2015, stated that the program remains on its revised schedule and budget for launch in late 2018, but that it will soon face some of its most technically challenging integration and testing, a phase when problems are often identified and schedules tend to slip. The JWST continues to receive close congressional oversight.

Other U.S. Civil Space Programs

NOAA Weather Satellites. NOAA operates geostationary and polar-orbiting satellites to provide data for weather forecasting and other purposes. Although NOAA's operational satellites differ from NASA's research-oriented Earth science satellites, they share some characteristics, and

improving coordination between the two agencies has long been a focus of congressional interest.

Landsat. The USGS operates Landsat satellites for land remote sensing, with applications in agriculture, regional planning, emergency response, and other areas. As with weather satellites, there is some overlap with NASA's research-oriented Earth science program. Views differ on the best approach to future land-imaging satellites. Some stakeholders advocate alternative approaches, such as privatization or international partnerships. Others prefer the current model: stand-alone satellites under USGS management. Other issues for Congress include cost control and data continuity.

Commercial Space

A survey by the Department of Commerce found that U.S. companies had \$62.9 billion in space-related sales in 2012. While U.S. government programs provided much of this market, about one quarter of sales were within the commercial sector.

New Space. Some observers have identified an emerging "new space" sector of relatively new companies focused on private spaceflight at low cost. One factor driving this trend is NASA's reliance on commercial providers for access to the ISS, but "new space" companies are also focused on other markets. These include the launch of national security satellites for the Department of Defense, the launch of commercial satellites for U.S. and foreign companies, and even space tourism.

FAA Regulation. The Federal Aviation Administration (FAA) licenses commercial space launch and reentry, including commercial spaceports. As part of the FAA licensing process, the federal government indemnifies launch providers against certain third-party liabilities. The U.S. Commercial Space Launch Competitiveness Act extended this indemnification policy (for the ninth time since 1988) through September 2025. The act also extended through September 2023 a statutory moratorium that restricts the FAA's authority to regulate the safety of crewed spaceflight. The status of human spaceflight safety regulations has been a focus of recent congressional interest because of NASA's plans for commercial crewed flights to the ISS.

Other Federal Roles. Several other federal agencies are also involved in the commercial space industry. NOAA licenses commercial imaging satellites. The Federal Communications Commission licenses the use of radio frequencies by commercial satellites and assigns locations for satellites in geostationary orbits. The National Transportation Safety Board investigates certain spacecraft accidents. The Department of Commerce Office of Space Commerce supports and promotes U.S. space commerce. Oversight of export controls on commercial communications satellites shifted from the Department of State to the Department of Commerce in 2014.

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