



March 20, 2015

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 \$18.0 billion in FY2015, 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, which is similar to H.R. 4412.

The 113th Congress passed appropriations legislation to fund NASA in FY2015. As usual, committee reports accompanying the House and Senate bills, as well as the explanatory statement accompanying the final omnibus bill, gave substantial programmatic guidance to NASA as well as directing the allocation of funds. The 114th Congress has begun to consider appropriations for FY2016 following the submission of the President's FY2016 budget, which includes \$18.539 billion for NASA.

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 NASA Authorization

Act of 2010 (P.L. 111-267) authorizes U.S. use of the ISS through 2020. In January 2014, the Administration proposed extending that date to 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. 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 start of operations is 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, 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 on December 5, 2014. The first test flight of Orion on an SLS, again without a crew, is planned for late 2018. The first test flight with a crew is expected in FY2021 or FY2022.

Mars is widely agreed to be the next 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 redirecting 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 with no landing.

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. Following the launch of two major Mars missions in 2011 and 2013, the Administration proposed reducing funding for NASA planetary science in order to fund science in other research areas. Congressional supporters of planetary science, especially Mars exploration, have opposed these proposed reductions each year since FY2013, with partial success.

Two NASA planetary science probes will reach their destinations in 2015. *Dawn* arrived at the asteroid Ceres in March, and *New Horizons* will arrive at Pluto in July. These will be the first two spacecraft to study dwarf planets at close range.

Earth Science. NASA funding for Earth science has risen from a low of \$1.2 billion in FY2007 to about \$1.8 billion in FY2015. 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 third such report, in December 2014, stated that the program remains on schedule and on budget, but that technical challenges have increased schedule risk. 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 114th Congress may revisit this indemnification policy, which has been renewed eight times since 1988 and currently expires on December 31, 2016. Although the FAA has the authority to regulate the safety of crewed spaceflight, a statutory moratorium restricts the application of that authority until October 1, 2015. This moratorium 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 Commercialization 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.

Daniel Morgan, dmorgan@crs.loc.gov, 7-5849