State **Fight**
A coast-to-coast battle to bring home the space jobs

**INSIDE**
- Space policy, geopolitics and the ISS
- The case for Space Debris Management
- The dangers of space alarmism

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To ensure the world remains a beautiful place, we’re helping place space at the heart of the global infrastructure that will help define the future. With space technologies that provide seamless connectivity, precision navigation, Earth observation and the utmost security, together we push the bounds of human knowledge. Follow our journey as we take the next great leaps forward to unite and protect our ever-evolving planet.
ABOVE: Bill Ochs, NASA James Webb Space Telescope project manager, monitors the progress of the observatory’s second primary mirror wing as it rotates into position Jan. 8. The $10 billion space telescope reached its final destination 1.5 million kilometers from the Earth on Jan. 24, wrapping up a nearly flawless month since its launch. The accuracy of JWST’s Dec. 24 launch aboard an Ariane 5 rocket means the spacecraft should have on the order of 20 years of fuel to maintain that orbit, double its original lifetime. Engineers will still need another five months to align the telescope’s mirrors and check out its instruments. Credit: NASA/Bill Ingalls
$200M

Chinese commercial rocket maker Galactic Energy raised $200 million in two funding rounds during the second half of 2021. The funding, raised in Series B and B+ rounds, goes towards development of the Pallas-1 medium-lift reusable launch vehicle and related infrastructure. That rocket, designed to place up to 5,000 kilograms in LEO, is slated for its first launch in early 2023. In December, Galactic Energy became the first Chinese private launch firm to successfully reach orbit twice with its smaller Ceres-1 solid-fuel rocket.

$55.6M

Chinese satellite imaging company ADA Space raised $55.6 million in a Series B round led by Hengjian Holding, an investment vehicle of the Guangdong Provincial People’s government. ADA Space is planning a constellation of 192 satellites to provide 1-4-meter imagery and is developing AI tools for analyzing those images.

$4.5M

Indian launch startup Skyroot Aerospace raised $4.5 million as a bridge to a future Series B round. The company, which has raised $17 million to date, is developing the Vikram line of small launchers and hopes to conduct a first launch by the end of the year.

$185M

D-Orbit is going public through a SPAC merger. The Italian company, which arranges rideshare launches of smallsats using its ION Satellite Carrier system, said it would merge with Breeze Holdings Acquisition Corp. in a deal that will provide up to $185 million in cash and value the company at $1.28 billion. Supporting the transaction is The Charles F. Bolden Group, an advisory firm founded by former NASA Administrator Charles Bolden.

CHINA’S GRAVEYARD SHIFT

A Chinese satellite towed a defunct navigation satellite out of geostationary orbit late last month. Data from space tracking firms ExoAnalytic Solutions and COMSPOC show that the Shijian-21 satellite docked with the defunct Beidou-2G2 navigation satellite (also known as Compass) and performed a large burn Jan. 22., moving the spacecraft out of the GEO belt. Shijian-21 undocked from Beidou-2 G2 on Jan. 26, leaving that spacecraft in a graveyard orbit well above GEO, and has since returned to GEO. Beidou-2 G2 failed in orbit following its 2009 launch, has been drifting since 2010 and may have partially fragmented at some point. China describes Shijian-21, launched last October, as a space debris mitigation satellite but has not released details about the satellite or its planned objectives.

CLOSE CALL

A Chinese satellite had a close call last month with a piece of debris from November’s Russian antisatellite (ASAT) test. China’s Space Debris Monitoring and Application Center issued a warning Jan. 18 of an extremely dangerous encounter between the Tsinghua Science satellite and one of more than 1,000 pieces of trackable debris from the ASAT test. Chinese officials claimed the debris came as close as 14.5 meters to the satellite, although the actual distance of the close approach is likely far more uncertain. The small, spherical Tsinghua Science satellite was launched in August 2020 on a Long March 2D rocket to make atmospheric density and gravitational field measurements.

BRITISH BUDGET BOOST?

The British government released a new military space strategy Feb. 1 that calls for more investment in space systems. The strategy projects spending an additional $1.9 billion over the next decade, primarily for a global constellation of satellites in low Earth orbit to provide surveillance and intelligence for military operations. The program, called Istari, also would fund advanced laser communications technology for high-speed delivery of data from space to Earth. In a related project called Minerva, the U.K. Space Command will experiment with a network of satellites that can autonomously collect, process and disseminate data from U.K. and allied satellites to support military operations. Chief of the Air Staff Air Chief Marshal Sir Mike Wigston said the strategy reflects the reality that “nefarious, reckless activities” are being conducted in space, and the U.K. wants to be at the forefront of ensuring space is available for everyone’s use.
Israel has signed the Artemis Accords. Uri Oron, director-general of the Israel Space Agency, signed the document Jan. 26, a little more than a week after the country’s foreign minister announced his country’s intent to join the accords. Israeli officials said they hope to use the agreement to enhance its space cooperation in the fields of research, science, and innovation. Israel is the 15th country to sign the Artemis Accords.

Israel Space Agency Director General Uri Oron signs the Artemis Accords during a Jan. 26 ceremony in Tel Aviv.

ESA may accelerate the launch of a radar imaging satellite after another satellite malfunctioned late last year. Sentinel-1B has been out of service since Dec. 23 after its radar antenna’s primary and backup power systems failed. Efforts to fix the power system have not been successful, but ESA Director General Josef Aschbacher said Jan. 18 that those efforts continue. A new satellite, Sentinel-1C, is nearing completion and currently scheduled to launch around the middle of next year. Aschbacher said ESA is looking into whether that satellite could be launched earlier, possibly by the end of this year.

Telesat is moving ahead with the ground segment of its Lightspeed constellation despite delays on the space segment. Danish equipment supplier Cobham SATCOM plans to install the first of 30 global landing stations in Canada, with construction set to begin in spring 2023. The ground infrastructure will be critical for providing the 15 terabits per second of global capacity that Telesat aims to offer with its full constellation. However, the satellites themselves are delayed because of pandemic-related supply chain problems affecting prime contractor Thales Alenia Space. Telesat has not yet fully secured the final $2 billion of the $5 billion needed to develop the LEO constellation.

SpaceX and Relativity Space were among the bidders for a NASA program to support development of commercial space stations. NASA released Jan. 27 the source selection statement for its Commercial LEO Destinations program, which provided funded Space Act Agreements in December to Blue Origin, Nanoracks and Northrop Grumman. The statement revealed that Relativity and SpaceX were among the 11 bidders, with SpaceX proposing a station based on the lunar lander version of its Starship vehicle, while Relativity offered a station based on its Terran R reusable launch vehicle. Neither proposal was funded.

A planetary scientist and university president will be the first woman to lead NASA’s Jet Propulsion Laboratory. Caltech, which operates JPL for NASA, announced Jan. 27 it selected Laurie Leshin as the next director of JPL, effective in May. Leshin is currently president of the Worcester Polytechnic Institute and previously held positions at NASA Headquarters and the Goddard Space Flight Center. She also is on the science team for the Curiosity Mars rover. She will become the first woman to lead JPL, established by Caltech in 1936 and operated by the university for NASA since 1958.

COLD CASH

Iceye raised $136 million in a Series D investment round to expand its synthetic aperture radar (SAR) satellite constellation. Seraphim Space, a longstanding backer of the Finnish radar satellite operator, led the round, with participation from several other investors. Iceye said Feb. 3 it plans to launch 11 satellites this year and will devote additional resources toward natural catastrophe monitoring. The company has raised $304 million to date.

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On the International Space Station, it is business as usual these days for the seven-person multinational crew. A Dragon cargo spacecraft undocked from the station Jan. 23, returning experiments and other equipment to Earth after a month-long stay. The prior week, the station’s two Russian cosmonauts, Anton Shkaplerov and Pyotr Dubrov, spent seven hours outside the station on a spacewalk working on the Prichal module, added to the Russian segment of the station in November. That spacewalk was covered live on NASA TV, much like those involving NASA and other western astronauts.

It is not, though, business as usual down on Earth when it comes to Russia’s relationship with the U.S. and the West. For months, there have been signs that Russia was massing troops for an invasion of Ukraine this winter. Those concerns have grown ever stronger to the point where some believe an invasion is all but inevitable.

“Do I think he’ll test the West, test the United States and NATO as significantly as he can?” President Joe Biden said at a Jan. 19 press conference, referring to Russian President Vladimir Putin. “Yes, I think he will.” He added later that while he didn’t think Putin had decided yet to invade, he expected Putin to do so. “My guess is he will move in. He has to do something.”

An invasion in the coming weeks would come nearly eight years after Russia entered eastern Ukraine and annexed Crimea. The stakes, though, are higher this time. “This will be the most consequential thing that’s happened in the world, in terms of war and peace, since World War II,” Biden said.

For the space community, the prospect of a Russian invasion of Ukraine raises questions about the future of cooperation between Russia and the West in space, particularly on the International Space Station. Russia’s annexation of Crimea in 2014 prompted sanctions by the West. In response, Dmitry Rogozin, then deputy prime minister, threatened to cut off the supply of RD-180 engines used by the Atlas 5 as well as deny NASA astronauts seats on Soyuz flights to the ISS—infamously suggesting that NASA would have to rely on a trampoline to get to the station.

Russia, though, never followed through on those threats: the RD-180 engines kept coming, and NASA astronauts kept flying on Soyuz missions. This time around, officials in the U.S. and Europe are trying to look beyond the tensions on the ground as they look to maintain their partnerships with Russia in space.
NASA administrator Bill Nelson, for example, has frequently emphasized the longstanding partnership between the U.S. and Russia in space, one that he argues stretches back to the Apollo-Soyuz Test Project in 1975. “NASA is in contact with our Russian colleagues all the time because, as you know, we operate the International Space Station together,” he said in a media call Jan. 11 to introduce a new chief scientist for the agency.

He’s frequently talked about going to Russia to meet with Rogozin, who is now the head of Roscosmos. (Rogozin cannot come to the United States because of sanctions that stem from his role in the events of 2014.) In the call earlier this month, he reiterated his plans to do so, with Covid playing a bigger factor than a potential invasion of Ukraine.

“I am simply at the mercy of Covid, and until we see a subsiding of this pandemic, I’m not going to be able to go,” Nelson said. “I’m looking forward to personally meeting Dmitry, and in the meantime, we’ll continue to talk as frequently as need be.”

In the event of a Russian invasion of Ukraine, the European Space Agency has to contend with potential disruptions with the ISS and a Mars mission with Russian involvement. ExoMars is scheduled to launch in late September on a Proton rocket, carrying the ESA-built Rosalind Franklin Mars rover that will be delivered to the surface of Mars on a Russian platform called Kazachok. That mission was to launch in mid-2020 but missed its launch window because of technical problems exacerbated by the onset of the pandemic.

At a Jan. 18 press conference, Josef Aschbacher, director general of ESA, was not concerned about geopolitics interfering with ExoMars or the ISS. “We want to separate cooperation in space from the bigger political picture on the ground,” he said. “I certainly believe that what happens politically on the ground will not change the plans towards the launch” of ExoMars.

“The space station is the best symbol of working together because we rely on each other, and we need each other, especially for big undertakings,” he added. “I do, honestly, want to underline that in space we do need a long-term cooperation. We need all the forces of space agencies worldwide.”

The terrestrial tensions complicate what is a key time for the ISS. On New Year’s Eve, the White House announced it supported an extension of the ISS through 2030, compared to the “at least 2024” date in current federal law. The announcement was not a surprise—NASA’s long-term ISS plans, and efforts to support development of commercial successors, expected the ISS to keep operating through the end of the decade—but still kicked off formal planning to extend the station’s life.

Immediately after the NASA announcement, ESA’s Aschbacher endorsed the extension, saying he will ask the agency’s member states to back ESA’s participation in the station through 2030, likely at the next ministerial meeting late this year. Canada and Japan are also likely to follow along.

“We’re very happy to see the announcement from the U.S. side. That’s helping the decision process,” said Christian Lange, director of space exploration planning, coordination, and advanced concepts at the Canadian Space Agency, during a panel discussion at the AIAA SciTech Forum on Jan. 6. “No one would have expected Canada to make a decision before the U.S. or even ESA or Roscosmos.”

“We were seeking the trigger by NASA to extend the ISS beyond 2024,” said Naoki Sato, exploration lead at the Japan Aerospace Exploration Agency, on the same panel. “With that trigger, we have just started the discussion for the extension of the ISS.”

Roscosmos, though, has not discussed its intentions about extending the ISS since the White House announcement. In recent months, Rogozin has been dismissive about a long-term extension because of what he said was the growing technical challenges of maintaining the aging station.

“The current agreement is that we’ll keep operating it until 2024. It can, of course, keep flying after 2024, but every next year will come at greater difficulty,” he said during a press conference at the International Astronautical Congress (IAC) in Dubai in October.
There has been greater progress on a near-term issue that ties the U.S. and Russia closer together on the ISS: swapping seats between Soyuz and commercial crew vehicles. NASA has advocated for a barter agreement that would allow NASA astronauts to continue to fly on Soyuz spacecraft in exchange for Russian cosmonauts flying on Crew Dragon and, eventually, CST-100 Starliner vehicles. Such “mixed crews” would ensure at least one NASA and one Roscosmos crewmember would be on the station if either Soyuz or commercial crew vehicles were unavailable for an extended period.

While NASA pushed for a barter agreement, Roscosmos was initially opposed, arguing that the commercial crew vehicles were not yet proven. However, at the IAC in October, Rogozin said he was now satisfied. “In our view, SpaceX has already acquired enough experience for us to be able to put our cosmonauts on Crew Dragon,” he said.

The seat barter agreement is in the process of being approved by the American and Russian governments. At a Jan. 18 meeting of a NASA Advisory Council committee, Robyn Gatens, ISS director at NASA Headquarters, said the agreement had completed a review by Roscosmos and was now in the hands of the Russian foreign ministry.

The goal is to complete the deal in time to allow a seat exchange this fall. Roscosmos announced in December that cosmonaut Anna Kikina would go on the Crew-5 Crew Dragon mission to the ISS, while NASA astronaut Frank Rubio is likely to go on Soyuz MS-22.

A backup cosmonaut for Soyuz MS-22 is Nikolai Chub, scheduled to go to the station on the Soyuz MS-23 mission next year. However, Roscosmos announced Jan. 22 that the U.S. government denied Chub a visa to come to the U.S. for routine training at the Johnson Space Center intended to familiarize Russian cosmonauts with the U.S. segment of the station.

Rogozin told Russian media and stated in his own social media postings that he would ask NASA why Chub was denied a visa. The U.S. State Department declined Jan. 24 to comment on the issue, noting that via records are confidential under U.S. law. A spokesperson added, though, that “the United States values the important bilateral cooperation on the International Space Station.” Two days later, the issue was resolved. Roscosmos said Jan. 26 that Chub received a U.S. visa.

The timing of the visa incident, though, can’t help with either near-term or long-term relations between NASA and Roscosmos on the ISS, or other aspects of international partnership, as geopolitical tensions grow. The same weekend that Roscosmos complained about Chub’s visa status, the State Department recommended that Americans not travel to Ukraine, and that Americans currently in the country leave.

Even if the ISS is unaffected by any repercussions from a Russian invasion of Ukraine and responses by the U.S. and other countries, it doesn’t mean space policy won’t be altered. While Russia never followed through on threats to cut off shipments of RD-180 engines, the threat, coming at the same time as SpaceX was suing the U.S. Air Force to win the right to bid on national security launches, reshaped the U.S. government launch market. SpaceX secured the right to compete for military launches and ULA, knowing the RD-180 supply would be shut off sooner or later, moved forward with Vulcan.

The threat of losing access to Soyuz seats, and thus the ISS, helped remove any remaining doubts about the commercial crew program. When SpaceX launched the Demo-2 mission in May 2020 with two NASA astronauts on board to the ISS, it was Elon Musk who said at a post-launch press conference, “The trampoline is working!”

An earlier version of this article originally appeared in the Space Review.
Cities, counties and states offer grants, tax incentives, land, facilities and workforce training to convince space companies to move.

“California will still and forever remain the startup capital of the world just because of the venture capital ecosystem,” said Sean Casey, former Silicon Valley Space Center managing director and co-founder of the New York Space Alliance. “You’ll always pull them in based on Silicon Valley, but can you hold onto them?”

In many cases, the answer is no. Companies leave California to open offices and production facilities in states with plentiful engineering talent, proximity to government customers and a lower cost of living.

Like Alabama, Colorado, Florida, New Mexico, Texas and Virginia, California benefits from its extensive U.S. government space infrastructure and the billions of dollars in federal funds that flow into government space programs. Unlike the other states, California has no state commission supporting the sector.

“California’s aerospace industry boasts a gross domestic product exceeding that of the state’s film and television and agricultural industries combined, but does not have a state commission like other major industries in the state,” said California Assemblyman Al Muratsuchi, chairman of the Select Committee on Aerospace.

Other states have adopted space strategies that play to their strengths. Space Florida welcomes new companies with financial packages tailored to their unique needs and offers facilities near the NASA Kennedy Space Center and Cape Canaveral Space Force Station.

SpaceX and Blue Origin are developing and launching rockets in Texas, a state known for less stringent regulation, generous relocation incentives and a lower cost of living than California, where SpaceX has its headquarters, or Washington, where Blue Origin is based.

The Michigan Aerospace Manufacturers Association wants to attract firms developing space and terrestrial technologies for 5G communications networks as part of a campaign that highlights the important role 5G networks will play in linking autonomous cars produced by state automakers.

The New York Space Alliance sees the state’s financial sector as a major resource.

“The way space gets financed is the existential question,” said Joseph Fargnoli, New York Space Alliance co-founder. “We want to get the institutional investors in New York conversant on the new space economy.”

Education is a key focus of many state and local organizations wooing space companies.

Through visits with elected officials, citizens underscore the role space companies play in local economies, and the high salaries space jobs provide. In colorful brochures for companies considering a move, states tout their educated workforce, top-notch infrastructure and unique attributes.

The California Space Authority played a similar role before the nonprofit ceased operations in 2011. A bill before the California legislature would establish a California Aerospace Commission.

“California needs to maintain its competitive advantage in the face of increased competition from other states, changes to the industry and shifting aerospace priorities,” Muratsuchi, the bill’s author and primary sponsor, said by email. SN
Virginia is for rockets

This could be a pivotal year for the Virginia Space.

Rocket Lab, the California company that has been sending payloads to orbit since 2018 on its Electron launch vehicle, may finally get the green light to begin flying rockets from the Mid-Atlantic Regional Spaceport on Virginia’s Wallops Island.

Since Rocket Lab selected the site in 2018, the California company has been working with the Virginia Commercial Space Flight Authority, which oversees the Mid-Atlantic Regional Spaceport, to get it up and running.

Planned launches in 2020 and 2021 were postponed due to delays in NASA’s effort to develop and certify an autonomous flight safety system for Electron launches. NASA said last month, though, that the certification should be completed in February.

If that happens, it will mark an important milestone for Virginia Space. To date, the NASA Wallops Flight Facility has been known for launching Northrop Grumman Antares rockets and Cygnus capsules to transport cargo to the International Space Station, and for launching sounding rockets.

Rocket Lab operates a private launch site on New Zealand’s Mahia Peninsula. When the company, based in Huntington Beach, California, was looking for a second launch site, it chose Wallops in part because Rocket Lab intends to conduct frequent launches of Electron and its new medium-class Neutron rocket and Wallops is not as busy as California’s Vandenberg Space Force Base or Florida’s Cape Canaveral Space Force Station.

To help seal the deal, Virginia promised Rocket Lab a $5 million grant.

In addition to the new Rocket Lab launch pad, the Mid-Atlantic Regional Spaceport opened a Payload Processing Facility in 2020 that can accommodate classified national security missions.

Virginia also is attracting startups. Herndon-based HawkEye 360 operates a constellation of radio-frequency-monitoring satellites. SpaceLink of McLean is working to establish a space-data relay constellation. LeoCloud of Ashburn is focused on satellite-based cloud computing. And TrustPoint, a firm developing a new global navigation satellite system, is based both in Northern Virginia and Silicon Valley.

U.S. defense and intelligence agencies are investing in startups that offer space-related products and services that complement government capabilities. Being in Virginia provides geographic access to customers in the Department of Defense and intelligence community, said Chris DeMay, TrustPoint founder and chief operating officer.

Since Virginia also is home to government agencies, federally funded research centers and defense contractors, “your odds are good in recruiting high quality NewSpace employees in Northern Virginia,” DeMay added.
Rocket city doesn’t intend to give up its title.

“Huntsville will continue to be a really important place for space in many regards, obviously on the propulsion and launch vehicles side of the house,” said Mike Ward, Huntsville Chamber of Commerce senior vice president for government and public affairs.

Huntsville is home to a Blue Origin engine production facility, Aerojet Rocketdyne’s rocket propulsion manufacturing facility and Dynetics work on NASA, U.S. military and commercial space programs. NASA’s Marshall Space Flight Center manages the Space Launch System and coordinates International Space Station experiments from Huntsville. Local employees also develop space station environmental support systems, manufacture space modules and perform space-based research.

“All of those things make Huntsville relevant today and relevant tomorrow,” Ward said.

In nearby Decatur, Alabama, United Launch Alliance manufactures Atlas, Delta and Vulcan Centaur rockets. Also nearby is U.S. Army missile development and testing at Redstone Arsenal.

To keep its space sector humming, the state of Alabama promotes aerospace engineering at University of Alabama campuses, Auburn University and Tuskegee University. Calhoun Community College offers instruction in the high-end skills communities need to attract aerospace employers like welding, 3D printing and computer numerical control machining, ensuring “the pipeline of labor development is robust,” Ward said.

The state, meanwhile, is making “investments on all fronts to support the industry, from education and workforce development programs to needed infrastructure and creating a business environment that allows companies to succeed here,” said Steve Sewell, executive vice president of the Economic Development Partnership of Alabama. “It is an absolute priority for Alabama, all the way to the highest levels in our state.”

That’s partly due to the economic contribution of the space sector. The historic achievements of Alabama’s space sector also are “a real source of pride” for the state, Sewell said.
Colorado wages international campaign in space sector

Competition to attract space companies is going global.

“Obviously, we are competing with our fellow states, but there’s even more competition for those companies that are looking for a U.S. location,” said Vicky Lea, aviation and aerospace director for the Metro Denver Economic Development Corp.

In recent years, Astroscale, the Japanese space sustainability company, Kleos Space, a radiofrequency-monitoring firm based in Luxembourg, and ground station operator Kongsberg Satellite Services of Norway have opened offices in Colorado.

In addition, Orbit Fab, a satellite refueling startup, announced plans in August to relocate to Denver from San Francisco.

“Silicon Valley is a great place to start,” said Orbit Fab CEO Daniel Faber. “There is capital and a creative mindset.”

When it was time to expand, Orbit Fab chose Colorado largely because of its talent pool and proximity to potential customers and partners.

Colorado also offered Orbit Fab tax incentives worth as much as $4.6 million based on its promise of creating nearly 200 high-paying jobs.

“Talent is a huge driver for aerospace growth here,” Lea said, noting prominent educational institutions like the University of Colorado, Boulder, and the Colorado School of Mines. “We have the nation’s second-most highly educated workforce.”

Colorado’s 290 aerospace companies employed 33,460 people in 2020, according to the report, “Aerospace Colorado: home to the most intelligent life in the galaxy.” The state also is strong in adjacent fields: software, energy and advanced manufacturing, “which broadens and deepens the talent pool,” Lea said.

For years, Colorado has attracted companies seeking military space talent thanks to the presence of U.S. Space Force Bases at Cheyenne Mountain, Schriever and Peterson, which is the current headquarters for U.S. Space Command.

Supporting local industry is a community-wide effort, Lea said, pointing to the attendance of government leaders, industry executives and academics at the annual aerospace day at the state capital. The annual event, sponsored by Colorado Citizens for Space Exploration, is designed to ensure Colorado legislators recognize the importance of the state’s space economy.

In the last five years, Colorado’s aerospace employment has grown 30 percent. The state now bills itself as having the nation’s highest concentration of private aerospace employment.

“We live and breathe aerospace,” Lea said. SN
At the outset of the coronavirus pandemic, city officials in Brownsville, Texas, anticipated double-digit declines in sales and property tax revenues. To their surprise, residential property values, sales tax collections and hotel tax revenues have continued to climb.

Much of the credit goes to SpaceX. The Hawthorne, California-based rocket builder has been steadily expanding the workforce at its nearby Boca Chica launch site for the Starship spacecraft and Super Heavy booster. SpaceX started ramping up activities at Boca Chica beach in 2016.

“Since then, Brownsville has attracted the interest of different industries and sectors that we thought would not have an interest in our community,” said Josh Mejia, CEO of Brownsville Community Improvement Corp. “Things like new space technologies, aerospace, tech companies. All of these industries want to be close to the big fish in the pond.”

In addition, people are moving from California and other parts of Texas to establish businesses in Brownsville.

SpaceX’s growing presence “has exponentially increased the entrepreneur activity that we have seen in our community,” Mejia said. “We’re talking about impacts and benefits that we will probably not see until 10-15 years from now.”

Brownsville is welcoming new companies by extending its broadband infrastructure and working with the state to prepare workers to meet the needs of its new businesses. The Brownsville Community Improvement Corp. also is talking with venture capital firms about creating startup accelerator programs and encouraging development of speculative buildings that could house manufacturing or assembly plants.

Still, navigating all these changes in a short time span poses challenges for Brownsville.

“Just like every great thing, there’s always going to be some negativity associated with it,” Mejia said. “So many elements are changing so quickly. They can have a positive result for the community, or a negative result based on how quickly you can pivot to meet the needs of the local economy.”

DEBRA WERNER
New Mexico’s growing reputation as a space state

Virgin Galactic named Spaceport America its flight operations center in 2009. The nonprofit NewSpace New Mexico was established in 2018 to encourage the growing commercial space ecosystem. “New Mexico has a lot of research and development, but it needs to be put into play to help companies move from concept to products to sales to money,” said Casey DeRaad, NewSpace New Mexico founder and CEO.

That’s the idea behind Unite and Ignite Space, a small satellite innovation hub in Albuquerque established through a partnership agreement between NewSpace

DEBRA WERNER
Michigan colleges and universities offer extensive instruction in aerospace research and engineering. After college, though, many graduates leave the state for jobs in California, Florida and Texas.

“We’re looking at building an entire ecosystem of value that supports growth and the retention of that talent that’s being trained here,” said Gavin Brown, executive director of the Michigan Aerospace Manufacturers Association.

The Michigan Aerospace Manufacturers Association is working to build Michigan’s space sector through projects like Space Enabled Connectivity for Advanced Mobility or SECAM. SECAM brings together public, private and academic organizations working on satellite and terrestrial technologies related to secure 5G communications networks. Among the beneficiaries of these global communications networks will be autonomous cars developed by Michigan’s automotive industry.

As part of SECAM, Michigan is securing funding for the Michigan Center of Excellence, a campus with office space and facilities for technology research, development, testing and evaluation. The SECAM campus is designed to attract organizations focused on various technologies from advanced manufacturing to artificial intelligence, cyber security, quantum and edge computing.

“Other parts of the country are focused on bits and pieces of this,” Brown said. “I think the real value comes from the entire ecosystem: engineering and prototyping to production.”

In December, Michigan Gov. Gretchen Whitmer signed a $1 billion package of investments and tax incentives to help the state bring in critical industries. SECAM and the other Michigan Aerospace Manufacturers Association initiatives could qualify for those incentives as well as for federal funding from the Commerce, Education and Energy Departments.

The Michigan Aerospace Manufacturers Association also is working with Midwestern research institutions, Wright-Patterson Air Force Base and the Air Force Research Laboratory to secure funding for the proposed Mid-America Hypersonic Suborbital Test Range initiative.

Through the Michigan Launch Initiative, the Michigan Aerospace Manufacturing Association leads a public-private partnership focused on identifying and establishing sites for horizontal and vertical satellite launches as well as a command and control center for satellite operations. SN
Shoring up Florida’s Space Coast

The Sunshine State’s efforts to lure commercial space ventures began well before the sun set on the Space Shuttle era.

When Terran Orbital was looking for a spot to build smallsats by the thousands, Florida offered the California company a $300 million financing package to open a massive new factory at Kennedy Space Center’s Launch and Landing Facility.

Terran Orbital, which is going public this quarter by merging with a special purpose acquisition company, expects to break ground this year on a 660,000-square-foot facility billed as the world’s largest. The state’s incentive package is likewise large, but the payoff could be huge: approximately 2,100 new jobs by the end of 2025.

“A lot of people are offering things like tax credits, which to a startup really means nothing,” said Marc Bell, Terran Orbital co-founder and CEO. “What Florida did was offer us a real financing package.”

JASON RAINBOW

Space Florida, the state’s aerospace economic development agency, is a heavyweight in the competition for space sector jobs.

Since it was established in 2006 to chart the Space Coast’s post-Space Shuttle future as a hub of commercial, civil and military space activity, Space Florida has helped facilitate “well over” $2 billion of investments across the state, said Dale Ketcham, Space Florida vice president for government and external relations.

In recent years, Boeing, Lockheed Martin, SpaceX, Blue Origin, Airbus OneWeb Satellites, Made In Space and others have established or expanded employment and facilities in Florida.

One of Space Florida’s most popular incentives for attracting businesses is conduit financing, where companies raise capital through tax-exempt municipal bonds to pay for property or infrastructure. Space Florida’s playbook also includes synthetic leases that can be recorded in financial accounts as an expense rather than debt, enabling companies to spread large expenditures over multiple years.

These sophisticated structures have existed for many years, but it “has only been in the last 10-15 years that we have had the opportunity to apply them to manufacturing and assembly facilities,” Ketchum said.

While some companies have considered moving to Florida and ended up elsewhere, Ketcham said no one has yet decided to leave the state after investing significant capital.

Space Florida works to retain companies by focusing on talent recruitment and development, Ketchum said. “If we have the talent available and a strong academic and industrial capacity, the marketplace will continue to find Florida a compelling location.”

By 2030, Space Florida aims to have facilitated more than $10 billion in transactions to position the state for emerging space opportunities, including off-planet manufacturing, energy production and tourism.

“A lofty goal, no doubt,” Ketcham said. “But when we look back on how far and how fast we have come since the devastating impact of the Shuttle retirement, we are confident and aggressive about the future for Florida.”

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Steve Howard is not superstitious, at least about a particular number. “Thirteen is my favorite number,” said Howard, the administrator of Camden County, Georgia, in early January.

Just a few weeks earlier, the FAA’s Office of Commercial Space Transportation (AST) awarded a launch site operator’s license, more commonly called a spaceport license, to Camden County, making it the thirteenth commercial launch site licensed by the agency. The license was the culmination of years of work, including extensive environmental reviews and coordination among many state and federal agencies. “This was a challenging project, with a lot of battle scars,” he said.

The license, though, is just the beginning of the project. The county on Georgia’s Atlantic coast now must acquire the land for the spaceport, build the launch facilities and attract launch providers. The spaceport still faces potential legal challenges, including a petition from county residents seeking a referendum that, if approved by voters, would effectively kill the project by blocking the county from buying the land.

Spaceport Camden would seem like a cautionary tale for other prospective spaceports that face regulatory, technical and business development challenges of their own. But state and local authorities pushing new projects seem undeterred by those obstacles or the fact that
That latter group included Francisco Partida, representing the airport in Brownsville, Texas, which started the FAA licensing process last year. He says the city wants to leverage SpaceX’s activity at its nearby Boca Chica, Texas, test site known as Starbase. “We’re the closest airport to that facility and, as such, we’ve been trying to position Brownsville as your gateway to SpaceX,” he said.

It’s unclear what sort of launch activity the airport, which hosts commercial airline flights, would support. In the near term, the focus is on developing land around the airport set aside for an industrial park. “We attracted SpaceX to be our anchor tenant,” he said, with the company leasing 9,200 square meters of warehouse space that could be expanded.

That’s a model that other FAA-licensed spaceports have followed. Spaceport Houston, located at Ellington Airport near NASA’s Johnson Space Center, has been licensed since 2015 but has never had a launch. The facility, though, is attracting a cluster of space companies, such as commercial space station developer Axiom Space and lunar lander company Intuitive Machines, who are building offices, test facilities and mission control centers there.

In West Texas, Midland Air and Space Port got an FAA spaceport license to support launches by XCOR Aerospace, which intended to fly its Lynx suborbital spaceplane from the airport’s runways. XCOR has gone out of business, but the airport has retained its FAA license and attracted companies from other parts of the space industry like AST SpaceMobile, which is developing a satellite constellation for mobile telephony services.

More companies, including those working on rocket engines, are coming to an expanded spaceport business park, said Oscar Garcia, a consultant representing Midland at the Global
Spaceport Alliance meeting. “We will have announcements soon of two new tenants,” he promised.

FUNDING AND REGULATORY ISSUES
Spaceports, though, have their share of problems, including the licensing process. Most spaceports don’t face the same challenges that Spaceport Camden did to get a license, but some in the industry see room for improvement for how new spaceports are licensed.

George Nield, the former FAA associate administrator for commercial space transportation who now chairs the Global Spaceport Alliance, believes there’s an opportunity to streamline spaceport licensing by defining a “minimum-impact spaceport concept.” If a proposed spaceport fell below thresholds for factors like the size of vehicles it hosted and population density, he proposed, it could get a license right away.

“That doesn’t mean you can launch a Falcon 9, but that’s OK,” he said. “You don’t need to launch a Falcon 9 to be a spaceport.”

The FAA is considering such concepts, said Pam Underwood, director of the office of spaceports at FAA/AST. The agency, which completed a revision of launch and reentry regulations in 2020 to streamline the licensing process, is turning its attention to other regulations, including spaceports. However, she said it was unlikely the FAA would get to spaceport regulations this year.

A bigger issue for spaceports is funding. Many prospective spaceports are not brand-new sites, like Spaceport Camden, but instead existing airports. However, they still need to build infrastructure for space activities, such as control centers, hangars and taxiways.

A long-running challenge for spaceports is a lack of federal infrastructure funding. Industry advocates have tried for years to establish a spaceport grant program similar to what is available for airports. They hoped the $1.2 trillion bipartisan infrastructure bill passed by Congress last year would include funding for spaceports. However, the final version, while including $284 billion in new funding for other modes of transportation, had nothing for space.

Nield blames that on the lack of advocates for the space industry, and spaceports in particular, in Congress. “There are few, if any, spaceport champions out there,” he said.

Airports that have spaceport licenses can seek FAA funding for infrastructure projects through the Airport Improvement Program (AIP) but are strictly limited to using that funding for aviation, not space, efforts. “Grant funding for airports is tough. AIP funding is very specifically for aviation,” Underwood said.

The FAA does have the authority to issue spaceport grants, she said, but has lacked funding for them. Underwood said her office is laying the groundwork for future spaceport grants by talking with others in the Department of Transportation on how they administer similar programs. “We can have a plan ready to go if we do get funding,” she said.

While the bipartisan infrastructure bill does not include any money specifically for spaceports, she added that those sites could seek funding the bill offers for other modes of transportation. A spaceport on the coast, for example, could get funding for port facilities, while others could get funding for road and rail projects.

Some spaceports have had success at the state level getting funding for projects. Cecil Spaceport, a former naval air station in Jacksonville, Florida, secured $13 million in grants last year from several state organizations, said Matt Bocchino, managing director of the spaceport. That funding will support new road and utility projects at the spaceport, which just completed a new air traffic control tower and mission control center.

State funding, though, brings with it its own issues. A prime example: Spaceport America in New Mexico, where the state spent more than $200 million for a spaceport with Virgin Galactic as the anchor tenant. With Virgin’s extensive delays getting its 18-year-old suborbital spaceflight venture into commercial operations, some are getting restless.

“We have a problem in New Mexico. We made a big investment and now we’re just saddled with this investment, and time keeps lagging on,” said Sen. George Muñoz, chairman of the finance
Despite having more than a dozen licensed spaceports, the vast majority of launches in the United States still take place from Cape Canaveral in Florida and Vandenberg Space Force Base in California. That's both an opportunity and a threat for new spaceports.

The Space Force has range modernization plans, known as "Range of the Future," to ensure it can accommodate that growth. That effort, though, worries some spaceports, fearing that Cape Canaveral will get federal funding that remains unavailable to them.

"For those of you worried about money, we're not asking for more money from appropriations," said Col. James Horne, deputy director of launch and range operations for Space Systems Command at Patrick Space Force Base, Florida. "We're using existing appropriations that we have traditionally leveraged to sustain that aging infrastructure to modernize it." That could include public-private partnerships to fund infrastructure improvements.

"We don't think we're competing with you," he told Global Spaceport Alliance members. "As a matter of fact, I think it's to our detriment if we do. We want to build a coalition of spaceports across the nation and the world, working together to really advance this industry."

David Buck, a retired Air Force lieutenant general who is now president of BRPH Mission Solutions, said he understands the concerns of other spaceports. "The Department of Defense will acknowledge they don't have the answers," he said. He predicted the Defense Department would eventually "get comfortable" with using other commercial spaceports.

"I'm an optimist about the future," he said but added that didn't mean every emerging spaceport will be successful. "I think about half of the non-traditional ranges getting licenses will fail."

Spaceport Camden's Howard is hoping to be in the half that succeeds despite the challenges it still faces. "We're looking to a very bright future as we come online," he said, including cooperating with other spaceports. "It'll be a win-win for everybody."
The past year saw 135 successful orbital launches worldwide, surpassing a record that had stood since 1967. While China edged out the United States 53 to 48, Florida’s Eastern Range commander Brig. Gen. Stephen Purdy: “We are prepared for a huge jump in activity.”

Eastern Range commander Brig. Gen. Stephen Purdy: “We are prepared for a huge jump in activity”

The Cape is busier than ever, but there’s room for more

Space Coast set a one-year launch record of its own. Thirty-one rockets reached orbit from Cape Canaveral Space Force Station and NASA’s neighboring Kennedy Space Center in 2021 — one more than SpaceX and United Launch Alliance combined to launch in 2020 from the Eastern Range to break Florida’s personal best of 29 successful orbital launches set in 1966.

Long the busiest space launch complex in the United States, Cape Canaveral and Kennedy extended their combined five-year streak as the busiest commercial, civil and military launch range in the world.

Space Force Brig. Gen. Stephen Purdy, commander of Space Launch Delta 45, expects the launch tempo to increase appreciably in 2022 at the Eastern Range, with as many as 66 orbital launches penciled on the calendar.

SpaceX, which launched 28 of Florida’s 31 orbital missions in 2021, is poised for another record year of satellite launches and human spaceflight missions, Purdy said. Although SpaceX hasn’t released a launch forecast for the year, a member of NASA’s Aerospace Safety Advisory Panel said during a Jan. 27 meeting that the company was planning for 52 launches in 2022 — most of which would launch from Florida.

The Space Coast’s projected 2022 launch totals also include several planned launches from United Launch Alliance, including the debut of its Vulcan Centaur rocket, the first flight of NASA’s Space Launch System heavy-lift rocket, and an unspecified number of missions for new smallsat launchers from Astra and Relativity Space slated for Florida debuts.

“We’ll see if they hold the schedule,” Purdy said of the small launchers. “But we are prepared for a huge jump in activity,” he told SpaceNews. “It’s a fascinating future for the Eastern Range.”

Purdy assumed command of the U.S. Space Force’s Space Launch Delta 45 at Florida’s Patrick Space Force Base in January 2021. Known as the 45th Space Wing when it was under the Air Force, Space Launch Delta 45 manages launch operations on the Eastern Range, which includes Cape Canaveral and Kennedy.
Purdy said he finds it striking that the vast majority of missions at Cape Canaveral will be commercial or civil for the foreseeable future. Only three national security space launches are scheduled for 2022. The long-term outlook for military launches is roughly five to eight missions in a single year, a small percentage of the overall launch activity.

“We have pivoted to become a commercial spaceport even though our reason to exist was national security launch,” he said. “It’s really interesting to see this.”

To keep up with the demand, the range has modified rules and procedures to help increase capacity and accommodate the fast-moving commercial industry.

“We’re really proud about the fact that we managed to onboard Astra to the range and got them ready to launch within six months,” said Purdy. “It previously took us over two years to onboard new launch providers.”

**A NEW COMMERCIAL SPACE ERA**

Several new launch vehicles are in various stages of preparation to start flying from Cape Canaveral and Kennedy over the coming year, including NASA’s Space Launch System moon rocket, ULA’s Vulcan Centaur and Blue Origin’s New Glenn. “And of course Starship as well,” said Purdy. Elon Musk in December announced SpaceX has started to build a pad in Florida for its massive Starship rocket.

Other new arrivals include Astra Space, a five-year-old startup that has been launching from the Pacific Spaceport Complex in Alaska, and is preparing to launch a NASA mission for the first time from Cape Canaveral. At press time, the company was expecting to receive a Federal Aviation Administration license by Feb. 4 and launch as early as Feb. 5.

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To keep up with the demand, the range has modified rules and procedures to help increase capacity and accommodate the fast-moving commercial industry.

“We tell ourselves that we have to mentally plan for 100 launches a year,” said Purdy. Even if that target is not realistic today, “it helps you get into that framework and mindset about what we can do to speed up our processes and our technology.”

**SMALL STEPS TO BOOST CAPACITY**

Piecemeal changes now being implemented will add up over time to increase productivity so more launches can be squeezed into the calendar, Purdy said.

Under the FAA’s new commercial space licensing rules, for example, fewer workers have to be evacuated during operations at the Eastern Range’s three busiest pads, Launch Complex 39, 40 and 41. By changing the risk analysis, “we can safely allow more people in the nearby area for a few more hours,” said Purdy. This new rule was first applied earlier this month when SpaceX launched the Transporter-3 rideshare mission carrying 105 small satellites.

Another recent action by the Space Force and the FAA was to renegotiate airspace use with the Navy in order to maximize launch windows, Purdy said. The U.S. Naval Ordnance Test Unit based at Cape Canaveral flies aircraft sorties and conducts Trident ballistic missile test launches from submarines. Six were launched in 2021.

These are examples of “things we’re doing to cram in more launch opportunities and capabilities,” he said.

How launch pads are designed and managed also can boost productivity, Purdy said.
Most of the launch providers at Cape Canaveral and Kennedy lease their pads for their exclusive use, but there are options to launch payloads from multi-user pads which provide more flexibility, Purdy said. “I’m a big proponent of clean pad concepts.”

So-called clean pads are intended to be shared by multiple launch companies. Clean pads provide the basic infrastructure, but the launch providers bring in most of the support equipment needed to fly the rockets, Purdy said. “They launch from a flat concrete area, and sometimes all they need is water, power and internet. Then they leave and they take all their equipment with them so the pad is immediately available to other users.”

Small rocket operator Relativity Space leased LC-16, a pad previously used by the U.S. Air Force, to launch its Terran 1 vehicle. Astra is launching its first demo mission from LC-46, a pad the Space Force licensed from Space Florida, the state’s economic development agency. “But our long-term thinking is to move them to LC-48, a clean pad area built by NASA,” said Purdy.

ABL Space Systems plans to conduct the first launch of its RS1 rocket from Alaska later this year but is also looking to launch from Cape Canaveral perhaps next year, said Purdy. However, that timeline could slip after a Jan. 19 test incident destroyed the RS1 upper stage. ABL’s first mission from Florida will be the launch of two prototype satellites for Amazon’s Project Kuiper broadband constellation.

Purdy said clean pads are ideal for companies like ABL that pack their ground system into shipping containers in order to launch from a variety of locations.

The Space Force wants to see the industry design more innovative pads to support an assortment of launch vehicles and fast turnarounds. “I want to find a way so that everybody wins,” said Purdy. “How can we apply maximum multi-use launch concepts and build a common pad design that allows maybe 16 companies to launch? That’s the stretch goal.”

**EQUIPMENT CHALLENGES**

A recent Defense Department inspector general audit found that both the Eastern and Western Range at Vandenberg Space Force Base, California, are challenged to maintain aging equipment, including instruments and telemetry antennas.

In a report published Jan. 5, the IG said the Space Force is at an “increased risk that aging range items with obsolete components could limit future launch capacity on the Eastern and Western ranges.” But the audit also found that the Space Force has successfully supported launches despite these challenges.

“Range item performance enabled successful launches for the 30 launches we reviewed out of 90 DoD, civilian agencies and commercial space launches that occurred between January 2018 and March 2021,” said the report.

Purdy’s take on the IG audit is that “they were really complimentary of what we’ve done,” he added. The problems associated with obsolete spare parts have been known for a long time, he added. “They highlighted some things that we’re aware of, and we’re monitoring.”

Some of the aging instrumentation used at the ranges is needed to support launch vehicles that don’t have automated flight safety systems, which track vehicle performance and autonomously destroy a rocket if it flies off course. SpaceX has used automated technology for many years, but Purdy said not every launcher has it. The Space Force plans to make autonomous flight safety systems mandatory by 2025.

Cape Canaveral is making upgrades to the communications infrastructure, Purdy said, so launch providers can use their own range instrumentation rather than rely on Space Force equipment.

Years ago, the Space Force chief of space operations, Gen. John “Jay” Raymond, started an initiative called “range of the future” that emphasizes using technologies such as autonomous systems to make launch ranges more efficient and less costly to operate.

“I really don’t like the term ‘range of the future,’” and I’m trying to change it” because it implies that the Space Force is looking 20 years out, Purdy said. Change is already happening and will...
be continuing, he said. “We’ve been constantly evolving for the last couple of years, changing business processes, changing safety analysis, changing our technology, and so we’re constantly evolving to get better and faster.”

Meanwhile, questions about DoD’s capabilities to support commercial launches have drawn congressional attention. The 2022 National Defense Authorization Act directs the Space Force to submit a detailed strategy to modernize the infrastructure at the launch ranges. Congress wants to know what investments are needed to update launch facilities for the new space economy and what legislative action might be required to allow the private sector to help pay for that.

Purdy said he is currently drafting content for the report, due in early April. He said the NDAA provision represents a “really unique opportunity” for a national conversation about space launch infrastructure investments and business models to meet future demands.

**NEW BUSINESS MODEL NEEDED**

There is no question that space launch facilities have to catch up to the new space age, Purdy said, noting that they were stood up decades ago for military use when commercial activity did not exist.

“The ranges were built back in the 1960s, and they were built in an era when all we had were national security launches,” he said. The rise of the private space industry calls for managing ranges more like a commercial airport.

Before the Space Force was established, the Air Force Space Command in 2019 floated the idea of converting the ranges into multi-use national spaceports that could better accommodate commercial and civil space launch demands.

That prospect is still being discussed, said Purdy, but federal spending rules are an obstacle to adopting a commercial business model. By law, DoD is responsible for operating and maintaining the ranges and cannot accept private funding for infrastructure upgrades.

“We have had commercial partners launch service providers come onto the campus and say, ‘hey, I want to give you money because I need to add this infrastructure piece to our pad,’” he said. “I cannot accept it. I am not allowed to accept money from launch providers to help them do what they need to do with their pads because of existing rules.”

As current law states, “we provide excess capacity to commercial launch providers,” Purdy explained. That means the Space Force and NASA can allow commercial companies to use existing launch pads and hangars, and the industry only pays for direct costs such as supplies and utilities.

The problem with that is there are overhead costs associated with all of those kinds of services that the government has to pay for, he added. The growing population of commercial players is putting more stress on the government workforce managing and maintaining services.

At some point, government resources will be overwhelmed, “and we’re going to slow it down because of that,” said Purdy.

The Space Force has been in discussions with NASA, the FAA, the launch industry and Wall Street investors to figure out a way forward, said Purdy. “We need to make a tweak so that we can accept funds from companies if they want to provide them. And secondly, we have to have a better approach on infrastructure.”

He said it is imperative to have a business model that allows users of the range to fund infrastructure and services. However, “I don’t want to dramatically increase the cost to the commercial industry. I really want to maximize our ability to launch, but we’ve got to get more into that sort of port authority model, where there’s additional funds that come in so we can get after some of those infrastructure improvements that can meet all the needs of the commercial providers without having a huge excess overhead.”

These reforms eventually will have to be taken up by Congress. “If we get to a point where we want to be able to accept commercial funds, that’s going to require legislation because I can’t do that now,” Purdy said.

But growth is a good problem to have, he said. Despite congestion and other challenges experienced at the Eastern Range, it will continue to be a preferred location as there aren’t many alternatives for vertical space launch.

Air-launch companies like Virgin Orbit can take off from airfields to deploy small satellites. “As a military commander, I like that flexibility,” Purdy said. “If you manage to find another location to launch, that’s great.”

But air launch today is limited to small payloads. The Pacific Spaceport Complex in Alaska and NASA’s Wallops Flight Facility in Virginia can support vertical launches of smaller satellites. But the reality, Purdy said, “is that if you’re talking vertical launch capacity for medium and heavy payloads, there’s really only a couple places to do it: Cape Canaveral and Vandenberg.”

“**The ranges were built back in the 1960s, and they were built in an era when all we had were national security launches,”** he said. **The rise of the private space industry calls for managing ranges more like a commercial airport.**
How America Can Become a Leader in Cleaning Up Space

During the first National Space Council meeting of the Biden administration, Vice President Kamala Harris reinforced the importance of outer space for national security, economic development, and environmental security. The future security and sustainability of space hinges on dealing with the over 8,000 metric tons of dead objects already in orbit, including at least 900,000 individual pieces of debris that can be lethal to satellites, which clutter the most heavily-used parts of Earth orbit today. To do this, the United States needs to implement a holistic Space Environment Management (SEM) program, and the most important missing element of that program is the development of remediation capabilities that can remove debris from orbit and help clean up the space environment.

Remediation is the act of reversing or stopping something, often used in the context of environmental damage. In the case of space, modeling done by NASA and other space agencies shows that we need to start removing at least 5-10 of the most massive debris objects each year to prevent the creation of future debris from collisions. Collisions involving these large objects can generate huge amounts of new debris that then increases the chance of another collision, creating yet more debris through a cascading collision process known as the Kessler Syndrome. At the same time, we also need to clean up the hundreds of thousands of small debris objects already whipping around the Earth. These “bullets” are too small to track reliably and thus cannot be actively predicted and dodged but could still cripple or destroy a satellite in a collision.

Despite the 2010 National Space Policy jointly tasking NASA and the Department of Defense to develop active debris removal (ADR) capabilities, very little work has been done. This inaction may be due to a combination of political and bureaucratic factors. Meanwhile, Europe, Japan, and the United Kingdom have all recently announced programs to fund the development of remediation capabilities and conduct initial demonstration missions. These international initiatives mean that the action to address space debris is being led elsewhere than the United States. The United States needs to get moving now to create a successful remediation program of its own and join this global effort.

A “successful” U.S. remediation program has several requirements. First, it must foster broad industry growth that creates jobs and economic opportunities. The on-orbit satellite servicing community, which includes ADR and other potential remediation capabilities, is a nascent but potentially powerful industrial sector. Satellite servicing represents a set of capabilities that could enable and enhance many other parts of the space industry and more sustainable, efficient, and sophisticated space capabilities.
that, in turn, create widespread economic development and opportunities.

Second, a national remediation program must address the regulatory and legal issues, not just the engineering challenges accompanying remediation. In most complex problems, science and engineering often turn out to be the easy part, while the cultural norms, regulatory framework, and public policy implications necessary for acceptance and implementation prove to be much more difficult. When you add in the international nature of space, these "non-technical" aspects are on the critical path for success and must be an inherent part of the program, not an afterthought.

Finally, a successful U.S. remediation program must create a sustained market beyond just government spending. This is likely the most difficult element to achieve and the most important. One-off government contracts and prize competitions are unlikely to meet this goal by themselves, particularly when faced with a large technological leap, non-technical regulatory obstacles, and a lack of a well-established market for customers. The recent history of space prizes such as the Ansari X-Prize and the Google Lunar X-Prize demonstrate this. While useful for generating public interest and advancing technologies, they do not have a good track record for yielding a sustainable, long-lasting commercial industry.

So, what is the pathway for the United States to establish a remediation program that hits all of these criteria? The best way to approach this is to model such a program on another successful space program — NASA’s Commercial Cargo and Crew transportation capabilities for low Earth orbit. This was done through a set of programs developed and run by NASA over the last two decades that included public-private sharing of the R&D costs, competitions to select multiple winners that met government capability thresholds while also being commercially viable, and the promise of government service contracts at the end. As a result, the United States now has a commercial capability to deliver cargo and crew to low Earth orbit for far less than it would have cost to develop a traditional government capability. Moreover, other governmental and private sector actors are now leveraging those same commercial capabilities, which could create a robust market that leads to further innovation and reduced costs.

The broader concept at work is known as advance market commitment (AMC) concept and was most recently used to pioneer the extremely successful mRNA vaccine development to combat COVID-19. Under the AMC model, the government, donors, or other entities promise to buy or subsidize a certain number of products at a price premium that gives a market incentive for companies to develop those products. The products can then be purchased by other government or private sector actors at market price.

This same approach should be adapted to develop a diverse set of commercial capabilities for orbital debris remediation. The program should be aimed at developing a set of capabilities for removing both large and small orbital debris as well as just-in-time collision avoidance that can prevent collisions without actually removing the debris and future technologies to reuse or recycle derelict space objects. It should also include commitments from the U.S. federal government to purchase the removal or remediation of a set number of debris objects a year and should be led by a civil agency, such as NASA or the Department of Commerce. The latter condition is crucial to help offset the international perceptions of such dual-use capabilities being developed by a warfighting military service such as the U.S. Space Force.

Ideally, the program would lead to the development of a robust set of commercial remediation capabilities from multiple companies that all governments can then leverage to reduce the near and long-term threat posed by orbital debris. Towards this end, the program should include remediation demonstrations involving both different countries and objects, such as a U.S. company removing a non-U.S. space object or vice versa. Doing so would help solidify several legal and policy grey areas currently acting as obstacles to a robust orbital debris remediation market.

Finally, the program needs to include funding for research on risk, cost-benefit analyses, and the economics of orbital debris to support future policy decisions. This research is needed to develop better tools to assess both the risk and costs posed by orbital debris to future uses of space, including commercial development and investment, which ultimately provides certainty to industry that their technology and financial investments will bear fruit.

The vision of space activities and capabilities to help address challenges on Earth and push humanity forward is clear but is only possible if we start managing the space environment today. The United States needs to live up to its role as the international leader in space by increasing its efforts for space environment management that includes a major investment in remediation. Doing so will go a long way to help ensure that the vision for a safe, sustainable, and stable space environment becomes reality.

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**IS EMPLOYED BY ASTROSCALE, A CONFERS MEMBER COMPANY.**
Space Traffic Management (STM) — the identification and deconfliction of potential mission-terminating collisions for operational spacecraft — has gained attention as the population of operational satellites in low Earth orbit has dramatically increased.

Operational satellites and their supporting infrastructure must be resilient and responsive to mitigate mission-ending or catastrophic collisions to maintain a safe and robust space industry. We applaud the efforts of organizations and policymakers to develop, synchronize, and refine STM principles, including data sharing, state vector accuracy improvement, near-real-time conjunction data messages, and expanding global space surveillance assets.

However, STM alone is insufficient to guarantee safe space operations. Space Debris Management (SDM) — the mitigation and remediation of space debris, including fragments and massive derelict objects — must be pursued with even more urgency than STM.

Micrometeoroids and orbital debris are increasingly cited as the cause of satellite anomalies. We can reduce the orbital debris side of the problem by eliminating the objects most likely to be involved in a collision. Our recent LEO Collision Risk Continuum paper reinforced that debris-on-debris conjunctions have a greater debris-generating potential than STM encounters (i.e., operational satellites against all resident space objects). Many thousands of massive derelict objects — defunct payloads and abandoned rocket bodies — have been left in similar orbits. These clusters of massive derelicts, along with large amounts of fragmentation debris, make large debris-generating collisions more likely at distinct altitudes. Specifically, our analysis identified the most likely collisions to be between spent Russian rocket bodies and Chinese and American debris fragments and non-operational payloads. These collisions are most likely to occur between 775 and 850 kilometers, making it the highest priority region for reducing the debris-generating potential.

This situation presents a unique opportunity for collaboration among the leading spacefaring nations to demonstrate the viability of active debris removal (ADR) and kick-start the commercial ADR industry. The U.S., Russian, and Chinese space agencies (NASA, Roscosmos, CNSA) should initiate a joint remediation mission to remove 20 of the statistically-most-concerning objects in LEO. The European, Japanese, and United Kingdom space agencies (ESA, JAXA, and UKSA) have already been trailblazers in this quest by mobilizing ClearSpace and Astroscale to perform ADR technology demonstrations. Examples of other technologies that have benefited from government support over the decades include satellite communications (Intelsat, Inmarsat), Earth observation (Landsat, SPOT), and SAR (SeaSat, Radarsat).

ADR is environmental protection — the space environment is home to vital capabilities to support such humanitarian endeavors as greenhouse gas monitoring, natural resource management, wildfire detection, and food security. The proliferation of operational satellites — and, indeed, collision risk — will only increase without timely intervention to remove decades-old massive derelicts. Simply saying that the problem is “too complex” ignores the warning signs. Humans are messy — we wait until a catastrophe occurs before we take the action that we know is needed. A marathon begins with the first step; let’s get started.

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Alarms raised over minor or imagined space threats are nothing new. In his successful 1960 campaign for president, John F. Kennedy seized on the dangers of the missile gap — a presumed Soviet superiority in the number of intercontinental ballistic missiles (ICBMs) — and exploited it all the way to the White House. Yet the missile gap was a myth. Secretary of Defense Robert McNamara admitted as much to Kennedy in 1962. McNamara explained that “emotionally guided but nonetheless patriotic individuals in the Pentagon” were responsible, and he noted, “There are still people of that kind in the Pentagon. I wouldn’t give them any foundation for creating another myth.”

Seventy years later, they’re at it again. A wide range of experts now warns the United States is losing a space race.
with China. China is developing "space capabilities at twice the rate" of the United States, and "if we don’t start accelerating our development and delivery capabilities, they will exceed us," General David D. Thompson, vice chief of space operations for the U.S. Space Force, warned recently. Thompson’s sober assessment echoed that of others, including NASA Administrator Bill Nelson, who called China a "very aggressive competitor" and a threat to American leadership in space.

Such fears are more fantasy than fact. The United States remains the most advanced space power in the world. Of the more than 4,500 satellites in orbit today, the United States accounts for more than half of them, some 2,700 satellites and nearly seven times as many as the next competitor — China. The Chinese hold the record for the most space launches in 2021 — a total of 55 launches to the United States’ 51. But the number of launches only tells part of the story because the United States has more powerful rockets, able to deliver more payloads — satellites, space probes, and spacecraft — to orbit. China’s space funding has increased markedly in recent years, to $8.9 billion in 2020, but still trails the $48 billion in U.S. government space spending. The United States also boasts a booming commercial space industry. Investors are pouring billions of dollars into the U.S. space economy as scores of start-ups seek to join the likes of SpaceX and Amazon in orbit. Meanwhile, China’s private space industry lagged behind, with funding trending in the wrong direction last year.

To be sure, China’s space program has made significant advances in recent years, from completing its own global satellite navigation system and collecting lunar samples to landing a spacecraft on Mars and sending astronauts to its own space station. But these milestones should serve as a reality check: the United States is not falling behind in the space race, so much as China is steadily catching up after having started so far behind. And China’s future space ambitions will still need first to clear significant technical and other obstacles. Taken together, these different metrics indicate the United States remains the world leader in space by a wide margin.

Still, the Chinese space-race narrative has helped to stoke fears and prompt calls for the U.S. to spend more on new military space capabilities, space exploration, and the commercial space industry. But the last thing Washington should do is seek to repeat the Cold War experience in space. As the victors of the Cold War, it is all too easy to forget just how dangerous the space race was — and is. Washington and Moscow’s tit-for-tat competition in space was fraught with unspeakable dangers and escalatory risks. In July 1962, the U.S. electromagnetic pulse test, code-named Starfish Prime, permanently disabled a number of U.S. and Soviet satellites and created an artificial radiation blast lasting a decade. It could have easily spiraled out of control; that Washington and Moscow managed to avoid armed conflict offers little reason to be sanguine about the dangers of U.S.-Chinese space rivalry. The Cold War space race was a risky game of one-upmanship, encouraging both sides to take shortcuts and accept higher accident risks. In October 1960, a Soviet general under political pressure to quickly test the new heavy-lift R-16 missile, neglected to clear personnel from the launch pad during fueling. When the liquid fuel in the booster’s second stage ignited, it caused a tremendous fireball that killed 126 scientists, engineers, and soldiers working at the site. Likewise, in 1967, separate accidents claimed the lives of three Apollo 1 astronauts and a Soviet cosmonaut — all in the haste to be the first to land a human on the moon. Today, accidents and malfunctions in space remain dangerous. As the low Earth orbit grows increasingly congested, so too does the danger of misperceiving accidental collisions as intentional acts of aggression. Much like the missile gap of the late 1950s, today’s rhetoric of “space doom” encourages a massive militarization of space that would tragically leave the United States poorer and less secure.

The United States faces real and significant security threats in space, but efforts to develop an effective space strategy must begin with a more clear-eyed net assessment. Promoting space cooperation with China would also help to dampen hype around a space race. While the Wolf Amendment limits U.S. government agencies, such as NASA, from cooperating with Chinese space agencies, the United States and China stand to mutually gain from collaboration for civil space exploration and science. Excluded from participation in the International Space Station or NASA’s Artemis Accords, the Chinese have had little choice but to develop their own space station and lunar base. These parallel space missions create a sense of a stark competition and fuel the space race narrative. Mutually beneficial scientific cooperation between the United States and China mitigates the risks of turning all U.S.-China relations into zero-sum competition. Let the missile gap myth be a cautionary tale.

Kelly A. Grieco is a resident senior fellow at the New American Engagement Initiative at the Atlantic Council’s Scowcroft Center for Strategy and Security. She received her Ph.D. in political science from the Massachusetts Institute of Technology and previously taught at the Air Command and Staff College.
Consolidation among satellite operators is a notoriously tricky and rare affair. Even when market conditions strongly suggest a merger would create significant financial and operational advantages, it is often seen as a non-starter in an industry rife with unique regulation and nationalistic protectionism.

Since leaving its roots as a nonprofit intergovernmental organization created in 1979, British satellite operator Inmarsat has successfully changed hands between public and private financial investors.

The last time was in 2020, when the company was sold to a group of mostly foreign financial investors in a $3.4 billion all-cash deal that took it off London’s stock exchange.

But will U.S.-based satellite operator Viasat’s plan to buy Inmarsat for $7.3 million through a mix of cash and shares also clear regulatory hurdles?

It’s uncharted waters for Viasat and the U.K., where new national security procedures only recently came into play.

The UK National Security and Investment Act 2021 (NSI Act), which came into force Jan. 4, gives the government more power to scrutinize and intervene in acquisitions of companies in space and other sensitive areas.

It forms the foundation of a new stand-alone mandatory regime that significantly expands national security review powers that previously came under the Enterprise Act 2002.

However, “national security” remains undefined, opening up a gray area for deal-makers.

**IMPROVING CHANCES**

The British government issued a public interest intervention notice under the Enterprise Act 2002 the last time Inmarsat was being sold.

That led to Connect Bidco, a consortium of two Canadian pension funds, New York-based Warburg Pincus and Apax Partners in London, pledging to keep core Inmarsat functions in the United Kingdom to push their deal through.

Those commitments included keeping Inmarsat’s main network operations center and skilled engineering resources in the country for a period of time after the acquisition.

Viasat has already made similar commitments as it continues to meet with British government officials to discuss the deal and what it means for Inmarsat’s assets.

Notably, the Californian company already has a foothold in the country through Viasat UK, which performs a variety of communications work for mostly the British government, particularly for data security and information insurance applications.

In March, some nine months before the Inmarsat acquisition was announced, Viasat opened cybersecurity and network operations centers in the U.K, saying they marked the start of plans to invest more than 300 million British pounds ($408 million) in the country.

The company said the investment is needed to lay the groundwork for its second of three planned ViaSat-3 satellites, which aims to cover Europe, the Middle East and Africa.

Announcing the plans to buy Inmarsat on Nov. 8, Viasat outlined intentions to build on the British operator’s U.K. presence and support the country’s recently published National Space Strategy.

Viasat signaled progress on the regulatory front in a shareholder letter accompanying its quarterly financial results Feb. 3, saying it continues to “expect the deal to close between nine and 18 months after signing, likely by the end of the calendar year.”

The letter also said it had submitted a pre-merger notification under antitrust regulations with the U.S. Department of Justice and “prepared regulatory filings for many additional jurisdictions around the world.”

As well as multiple regulatory hoops that Viasat must fly through on both sides of the Atlantic Ocean, the Nasdaq-listed company’s shareholders also need to give their approval for the deal to go ahead. A shareholder vote on the acquisition has not yet been scheduled.

In the meantime, Viasat said Feb. 3 that it had started internal integration planning for its largest-ever acquisition, setting the company up to expand across multiple orbits and spectrum bands in a transforming industry. SN
When the U.S. Space Force was established in December 2019, it was purposely sized small to minimize cost and bureaucracy, and was created primarily with existing military personnel and funding.

With a projected force of 16,000 people, the space branch is tiny compared to its parent service, the U.S. Air Force, which has nearly 650,000 personnel.

In its third year, the Space Force is finding that being small has some advantages, such as flatter chains of command and more flexibility to try out new concepts. It is also becoming clear that because of its size, the Space Force will remain hugely dependent on the Air Force to perform its activities and, as a result, may struggle to define a distinct identity.

That reality was brought home by Air Force Secretary Frank Kendall, who commented last month that the Space Force is indeed an independent service but will need to stay “tightly coupled to the Air Force” to succeed.

Space Force leaders insist that the service is making strides as a separate branch. Chief of Space Operations Gen. John “Jay” Raymond said the Space Force does not plan to be “an air force that changes a little bit here and there.”

Meanwhile, some outside observers caution that a lack of resources undermines the Space Force.

David Deptula, a retired Air Force lieutenant general and dean of the Mitchell Institute for Aerospace Studies, contends that the Space Force doesn’t have enough people or money to meet the national security demands of the space domain.

To make matters worse, the ongoing battles over federal spending are disproportionately impacting the Space Force, Deptula said on a recent podcast.

Congress has not passed a budget for fiscal year 2022, and the government has been funded since Oct. 1 by a stopgap measure that freezes funding at last year’s levels. New programs are not allowed to start under a continuing resolution, and budget uncertainty slows progress to a crawl, Deptula noted.

The failure to pass a 2022 budget is especially detrimental to the Space Force because most of its money is tied up in new programs. Raymond warned that unless a budget is passed soon, two of five planned national security satellite launches will slip from fiscal year 2022 to 2023, and several satellite programs will see delays.

If the Space Force cannot deliver the space systems the military needs, its clout will be diminished, said John Baum, senior fellow at the Mitchell Institute.

“Bureaucratically, the Space Force is unfortunately still fighting to justify its existence,” Baum noted. Even the staunchest supporters of the Space Force will grow impatient if the service cannot show progress modernizing U.S. space systems soon, he said. The Space Force has a lot of new programs “that need funding increases that a CR puts the kibosh on.”

This is a valid point, as one of the major reasons Congress supported the Space Force as a separate branch was the imperative to rapidly field capabilities that did not exist when space was under the Air Force.

Budget crises aside, the Space Force will have to overcome its lack of size by pushing innovative ideas and showing new approaches in the acquisition of space technologies. Military spending is projected to stay flat at best, making it improbable that the Space Force will see any substantive growth in personnel or funding.

Kendall noted that the significance of space in national security ensures the relevance of the Space Force, regardless of its size. As he put it, the Space Force is “very small relative to the other services. But in terms of importance, it’s at least equal to the other services.”

“Congress’ failure to pass a 2022 budget is especially detrimental to the Space Force because most of its money is tied up in new programs.”

“Trying to punch above your weight with one hand tied behind your back.”
# ON THE HORIZON

## FEBRUARY

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| 8-10 | SmallSat Symposium  
smallsatshow.com | Mountain View, CA |
| 16-17 | FAA Commercial Space Transportation Conference  
www.commercialspaceflight.org | Washington, DC |

## MARCH

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| 21-24 | Satellite 2022  
www.satshow.com | Washington, DC |
| 4-7 | 37th Space Symposium  
www.spacesymposium.org | Colorado Springs, CO |
| 14-15 | Paris Space Week  
www.paris-space-week.com | Paris, France |
| 17-19 | Humans to Mars Summit  
www.exploremars.org | Washington, DC |

## APRIL

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| 4-7 | 37th Space Symposium  
www.spacesymposium.org | Colorado Springs, CO |

## MAY

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| 17-19 | Humans to Mars Summit  
www.exploremars.org | Washington, DC |

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### International Academy of Astronautics

**8th Annual Space Traffic Management Conference**  
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[https://iaaspace.org/scitechforum](https://iaaspace.org/scitechforum)
Maintaining Mars madness

Compared to 2020, this will be a quiet year for launching Mars missions. The last time the once-every-26-months Mars launch window opened, NASA launched the Perseverance rover, China its Tianwen-1 mission and the United Arab Emirates the Hope orbiter. When the next window opens this fall, the only mission scheduled to launch is Europe’s ExoMars, and that mission was postponed from 2020 because of technical problems and the pandemic.

At Mars itself, though, this year will be busy. The three missions launched in 2020 are all active on and around the red planet, including Perseverance, which is preparing to head towards the remnants of an ancient river delta in Jezero Crater, collecting samples along the way.

NASA and the European Space Agency are still working to better define the two later missions that will bring those samples back, with a NASA review of those plans pushed back to the spring, officials said at a meeting of the Mars Exploration Program Analysis Group (MEPAG) advisory committee in early February. Both the NASA-led lander and ESA-led orbiter are supposed to launch in 2026, although an independent review in late 2020 concluded those missions would likely slip to 2028.

Mars Sample Return dominates the agency’s Mars plans for the rest of the decade. NASA’s only other large mission in progress is the International Mars Ice Mapper, or I-MIM, an orbiter equipped with a radar mapper to look for subsurface ice deposits that could support later human missions. I-MIM, which includes contributions from Canada, Italy and Japan, had been scheduled to launch in 2026, but officials at the MEPAG meeting said it will now fly no earlier than 2028.

That’s putting pressure on scientists to get the most of the existing spacecraft on and orbiting Mars, some of which are quite old. Mars Odyssey has been orbiting Mars since 2001, and NASA hopes to get another five years out of the spacecraft. Two other orbiters, Mars Reconnaissance Orbiter (MRO) and MAVEN, launched in 2005 and 2013, respectively, are expected to work through the end of the decade.

Those missions are feeling squeezed by proposed flat budgets. “It takes more work for an aging spacecraft and a legacy ground data system to keep up with new requirements,” said Rich Zurek, MRO project scientist, at the MEPAG meeting, citing revised cybersecurity rules and science data formats. That reduces the funding available to support science by those missions.

The Mars science community is looking to the upcoming planetary science decadal survey for guidance on future missions. Lori Glaze, director of NASA’s planetary science division, said at other recent meetings that she expects to get the final report in late March or early April, with a public release likely in mid-April.

The previous planetary science decadal picked as its top-priority large mission a sample caching rover that became Perseverance. It’s unlikely a Mars mission will come out on top this time, so scientists are looking at lower-cost options.

That includes lander missions that could be relatively inexpensive. A report presented at the MEPAG meeting found that advances in technology, along with low-cost launch services, made feasible a line of Mars missions costing a couple hundred million dollars a year, similar to what NASA is currently spending on the Commercial Lunar Payload Services program.

“These missions would be a component of the Mars program, but not the sole program,” said Bethany Ehlmann of Caltech, one of the leaders of that study.

As scientists await the decadal survey, they’re hoping to keep the current Mars missions running for years to come — all but InSight, the lander whose solar panels are increasingly covered with dust, reducing their power. Bruce Banerdt, the lander’s principal investigator, said at MEPAG he expects those power levels to drop below what’s needed to keep the lander alive by the end of the year.

He added the mission had submitted a proposal to NASA should InSight somehow manage to keep operating beyond the end of 2022. “But we’re not betting our mortgage on it.” SN
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