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THE FUTURE OF CIVIL AND COMMERCIAL SPACE AUTHORIZATION AND OVERSIGHT

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After the November 2020 presidential election, members of the U.S. space community began speculating on what the new administration would do regarding space policy formulation and oversight in the Executive Office of the President. Discussions centered on whether the National Space Council, which had been reestablished in 2017, would be continued, and, if so, how it would operate. As the space community monitors this situation, it is equally important to ensure that the U.S. Congress continues the evolution of its committee structure and processes for guiding the U.S. government's space efforts. This paper examines congressional space authorization, including a brief discussion of its history and a look ahead to future organizational and information needs as the nation's and the world's space enterprises grow.

Committee Workload, Today and Tomorrow

Representative Don Beyer became the chair of the House Subcommittee on Space and Aeronautics at the beginning of the 117th Congress in 2021. In an interview that May, he spoke of the early meetings held by the subcommittee's members and staff to determine the agenda and priorities for the year. According to Chairman Beyer, this effort generated enough ideas to fill three to five years. He stated that the biggest roadblock to the subcommittee's work is time, and that "nothing would delight me more than a space committee hearing every week."[1]

The growth and diversity of space activities in the twenty-first century may compel the congressional oversight committees to continue an evolution that began in 1958. Business projections depict space commerce, which had global revenue of $424 billion in 2019, as the next trillion-dollar industry, doubling or tripling in size from 2020 to 2040,[2] or by some estimates even faster.[3] An ambitious forecast from China envisions a space economy worth $10 trillion annually by 2050.[4] If a significant fraction of these optimistic predictions are realized, space activity is poised to dramatically expand in scope and importance in the next quarter century. As a result, new technical and business developments, new players, and shifting priorities may elevate the stature of the nation's space policy, regulations, and investments, prompting more attention from the relevant committees in the House and Senate. The anticipated pace of space-related growth may make an already ambitious committee workload even more challenging.

Current and former participants in the space authorization process, on Capitol Hill and elsewhere, were interviewed for this paper from May through July 2021. Opinions varied regarding whether the organization and jurisdiction

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of committees would need significant revision, or are sufficient as currently configured to meet the requirements of the next generation. The interviewees—experienced professionals fully aware of the anticipated growth of civil and commercial space—were not willing to speculate on what the future of the committees may look like. Their focus is on the demands of the current session of Congress. This author is not similarly constrained and believes it is valuable to speculate on possible futures to improve preparedness. The process starts with a look at where we are and how we got here.

Space Authorization Committees' Continuing Evolution

Every two years, at the beginning of each new Congress, lawmakers have an opportunity to reorganize the committee structure: create new committees and subcommittees; eliminate, rename, or change the jurisdiction of existing committees; and of course, populate the committees and choose their leaders. This latter step tends to be the one that gets the most media attention, while the other actions typically are seen as the "inside baseball" of the legislative branch.

At the beginning of 2021, a subtle change occurred in the Senate committee that oversees civil and commercial space issues. It was a seemingly minor adjustment, executed with intentions no grander than bringing better balance to subcommittee workloads. In the long term, it could turn out to be the first of many changes needed to allow congressional space oversight to keep pace with the anticipated growth of space activities.

The Senate Committee on Commerce, Science, and Transportation has civil and commercial space issues in its portfolio. In the 116th Congress, these issues were the responsibility of the Subcommittee on Aviation and Space, which had jurisdiction over astronautical and aeronautical research and development; national and civil space policy; civil aviation research, development, and demonstration; and aviation safety and consumer protection. This gave the subcommittee oversight of NASA and the civil aviation and space components of the Departments of Commerce and Transportation.[5]

At the start of the 117th Congress in 2021, Senate Commerce reorganized its subcommittees, creating one titled "Space and Science" and another named "Aviation Safety, Operations, and Innovation," sharpening the focus in both of these active issue areas. The jurisdiction of Space and Science includes national and civil space policy; science, technology, engineering, and math research, development, and policy; and standards and measurement. This involves oversight of NASA, the Federal Aviation Administration (FAA) Office of Commercial Space Transportation, the Department of Commerce Office of Space Commerce, the National Institute of Standards and Technology (NIST), the National Space Council, the National Science Foundation (NSF), the White House Office of Science and Technology Policy (OSTP), and the United States Arctic Research Commission.[6]

It could be argued that the separation of aviation and space was long overdue because the two issue areas have more differences than commonalities when it comes to policy, law, and regulation. Additionally, a single subcommittee serving aviation and space could become overburdened in its workload as both issue areas grow.

On the House side, the Subcommittee on Space and Aeronautics of the Committee on Science, Space, and Technology handles civil and commercial space issues. The subcommittee's space-related jurisdiction covers astronautical research and development (R&D); national space policy and law, including international cooperation; and space exploration and commerce, including orbital and suborbital access and space applications such as communications and remote sensing. The subcommittee is responsible for NASA, as well as commercial space activities of the departments of Commerce and Transportation, including R&D, licensing, and regulation.[7] In addition to all of this, the subcommittee oversees civil aviation R&D and demonstration, including all related FAA programs. The non-R&D aspects of aviation are addressed separately, in the Subcommittee on Aviation of the House Committee on Transportation and Infrastructure, which in recent years has asserted jurisdiction over space-related issues at the FAA because launches and reentries must be integrated with the National Airspace System.[8] Further dispersion of space oversight could occur if the House Committee on Energy and Commerce takes increasing interest in the space-related activities of the Department of Commerce.

Although Senate space committees traditionally have defined their jurisdictions more narrowly than their House counterparts, the current arrangement has civil and commercial space in the Senate consolidated in one committee (Commerce) while the House has multiple claimants to space oversight. The multiple lines of authority in the House and lack of organizational synchronization with the Senate may be an inconsequential concern in the near term. But what if the anticipated growth of civil and commercial space activities outstrips the ability of the current arrangement in either chamber to sufficiently keep up with its policy and oversight responsibilities? Fortunately, the committee system has the tools to evolve into what is needed and has used those tools many times since the beginning of the Space Age.

The Path Followed—and Where It May Lead

In the wake of the Soviet Union's launch of Sputnik 1 on October 4, 1957, the House Committee on Astronautics and Space Exploration and the Senate Committee on Aeronautical and Space Sciences were created, first as select committees during the 85th Congress in 1958, then becoming permanent committees the following year in the 86th Congress. (See Appendix A for comparisons of jurisdictions, then and now.) The committees developed the National Aeronautics and Space Act, which was signed into law in July 1958.

The House Committee on Science and Astronautics was the first standing committee created in that chamber in 11 years and the first since 1892 to focus on an entirely new issue area. The committee's initial jurisdiction included exploration and control of outer space, scientific and astronautical R&D, and science scholarships. The agencies initially under the committee's jurisdiction included NASA, the National Bureau of Standards (now called NIST), the National Aeronautics and Space Council, and the NSF.[9]

By 1962, the House Committee settled on a subcommittee structure that would set the stage for the Apollo era, with occasional adjustments. Illustrating the dominance of space on the committee's agenda, the permanent subcommittees included:

- Manned Space Flight
- Advanced Research and Development
- Space Science
- Applications and Tracking and Data Acquisition
- Patents and Scientific Inventions

Two special subcommittees also were established to address issues considered to be short-term: Solid Propellants and Women as Astronauts.[10]

By the mid-1960s, congressional leadership began to recognize the need for better mechanisms to address the full range of science and technology issues, including all federal nonmilitary R&D. This led to gradual expansion of committee jurisdictions in both the House and Senate. For example, by 1974, the House Committee's jurisdiction had expanded to include energy, the environment, the atmosphere (including the National Weather Service), and civil aviation R&D, and its name was changed to the Committee on Science and Technology.

As the House space committee morphed into a broader science committee, it was downgraded from a "major" to a "nonmajor" committee (in today's jargon, from an "A" to a "B" committee), and space was relegated to a single subcommittee. A similar evolution took place in the Senate Aeronautical and Space Sciences Committee, shifting NASA authorization and oversight to the subcommittee level in 1977 under what is now the Senate Committee on Commerce, Science, and Transportation.[11]

In general, the congressional reforms of the 1970s brought increased resources and independence to subcommittees. But space issues, in contrast, lost stature as they were downgraded to a subcommittee where once they had been the dominant focus of a major committee.[12]

Committee name-changes occurred on multiple occasions in the years to come. For example, in the House, the

Committee on Science and Technology added Space back to its title in 1987, but, when Republicans took control of the House in 1995, they shortened the name to simply Committee on Science. Democratic control returned in 2007 and so did the Science and Technology name, which lasted until 2011 when Space was reinserted, reestablishing the committee name that remains in use today.[13] Fortunately for NASA, all of the renaming and reshuffling of committee jurisdictions did not spread oversight responsibility for the agency's core programs across numerous panels.

If we look ahead just a few years, it is not difficult to envision circumstances that will compel congressional committees to address growth in the scope and complexity of space applications and greater diversity among space operators. Future congressional leadership will determine what structural and procedural changes may occur and when, but it is not too early to begin assessing the options.

Increasing salience of space issues over the next 10 to 20 years could spark the **return of a full committee dedicated to space** in each chamber of the U.S. Congress. The committees' workloads and those of their subcommittees could include a challenging array of new and expanding topics:

- Civil and commercial human spaceflight, including research and exploration missions, space tourism, and the transition from the International Space Station to commercially operated platforms
- Space domain awareness, traffic management, and orbital debris, including airspace integration for launch and reentry operations
- Sustainable cislunar development, including traditional space applications plus on-orbit servicing and construction, ongoing lunar operations, extraterrestrial resource use, space manufacturing, and other space infrastructure deployment and operations
- Space science and robotic exploration, some of which may be conducted by nongovernment entities
- Weather, climate change, and environmental monitoring, including space weather
- Space technology R&D and workforce, including academic grants, scholarships, and training
- International, intergovernmental, and public-private collaboration in space efforts

Scenario: Growth and Diversity in Space Activities, Mid-2030s

- **Space services** include far more than communications, navigation, and remote sensing. Operators also offer on-orbit servicing and refueling, debris remediation, orbiting laboratories, and space tourism.
- **Sustained operations on the lunar surface** are being established by NASA, other national space agencies, and nongovernment organizations.
- **Public-private partnerships**, including many with participation by organizations not traditionally associated with space, have become prominent in a variety of pursuits, including:
  - Space traffic management
  - On-orbit laboratory facilities and research programs
  - Lunar exploration and development
  - Cislunar communications, navigation, and space weather
  - Cislunar power generation and distribution systems
- To enhance stability for long-term planning, and to boost the confidence of investors and customers, space operators are seeking **increased government involvement and/or oversight** in:
  - Space rescue capabilities and procedures
  - Training and certification of astronaut pilots
  - Standardization of life support and safety systems
  - Legal and regulatory responses to space tourism casualty events
  - Lunar resource claims
  - Export control and taxation issues for products manufactured in space

Alternatively, **space subcommittees could be added across the Congress**. For a long time, the space community has highlighted the increasing integration of space technology with all aspects of society. If space is such a pervasive activity, it may require representation throughout the committee structure, not segregation in a specialized space committee.

Among the committees in the House, for example, there could be eventual need for space subcommittees supporting jurisdictions other than Science, including Agriculture, Armed Services (a more focused version of the Strategic Forces subcommittee), Energy & Commerce, Homeland Security, Intelligence, Natural Resources, and Transportation & Infrastructure. Depending on the topic, select committees could require space expertise as well, such as the 117th Congress's Select Committee on the Climate Crisis. One consideration with this approach is that it could create a heavy demand from multiple subcommittees for testimony by space-related executive branch organizations.

Another possibility suggested by an interviewee is a **revised space committee structure linked to the National Space Council** (NSpC) or another government-wide coordinating body in the Executive Office of the President. In keeping with the whole-of-government approach to fulfilling the nation's needs and ambitions in space, congressional committees could strive for an overarching space strategy in collaboration with the NSpC efforts to do the same. While it would be advantageous to improve the coordination of the executive and legislative branches in establishing national space policy and strategy (e.g., assigning agency responsibilities, minimizing unnecessary duplication, and settling interagency disagreements), this approach may be more viable if both branches are controlled by the same party and, even then, could prove difficult due to competing jurisdictional incentives.

The Senate space subcommittee's recent adjustment of its jurisdiction may be the first small step toward an authorization and oversight process that is reorganized to handle the next generation of space activity. Committee evolution may be slow and subtle, as current space authorization professionals believe, but circumstances could drive more dramatic changes. Space actors are increasing in number and diversity; continuous operational space activity is poised to move beyond geosynchronous orbit; sovereignty and property rights issues will need to be resolved; and space services, traditionally defined by the movement of electromagnetic signals, will grow to include the movement and interaction of physical objects.

Enhancing Scientific and Technical Advice to Congress

Another evolutionary step that may be needed is improvement of members' and committees' ability to digest large and growing flows of technical and operational information in a way that enhances, rather than confuses, decisionmaking. Access to sufficient expertise is essential for policy formulation and oversight in any highly technical area. Space technology is a prime example of an issue area dominated by esoteric knowledge in a variety of disciplines.

In the earliest days of the space program, expertise was highly concentrated in executive agencies (specifically, NASA and the Department of Defense) and in the agencies' prime contractors and academic grant recipients. Since that time, space expertise has grown dramatically in scope and complexity, and legislators have been challenged to keep up. In other words, there is no longer a scarcity of information but rather an overabundance that must be filtered and absorbed. Congress has tapped into academia, industry, professional associations, and other special interest groups in attempts to overcome its traditional information imbalance with the executive branch. Today, the difficulty is assimilating the information in ways useful to decisionmakers in a legislative body that has limited absorptive capacity for technical subjects.

At the outset of the Space Age, Congress had practically no in-house space expertise, so the recruitment of technically competent staff was a priority for the newly formed House and Senate committees on science and astronautics. The recruitment task proved difficult. By February 1960, the House space committee was being criticized by *Aviation Week & Space Technology*, the aerospace industry's weekly trade magazine, for the staff's lack of technically qualified professionals and for excessive recruiting of staff in the chairman's home district in Louisiana.[14] It took until the 1980s to build substantial in-house capability in the space field, and this

has been difficult to maintain due to relatively rapid turnover in staff positions and strong competition from industry for technical talent.[15]

Congress has long recognized its need for research and analytical support beyond what could be provided by committee and personal staff. The Government Accountability Office (GAO, formerly called the General Accounting Office) was created in 1921, the year that the president started submitting annual federal budget requests. GAO audits the performance and finances of federal programs. Meanwhile, the Congressional Research Service (CRS), part of the Library of Congress, provides concise, quick-turnaround analyses at the request of members and committees. These two support agencies were joined in the 1970s by the Congressional Budget Office (CBO), which performs nonpartisan analysis of budget implications and projections for future funding requirements. All three of these organizations have released space-related reports in recent decades, but space has been a very small part of their portfolios and their reports tend to be aimed at a narrow set of questions posed by members and committees.

Broader, more in-depth investigations of technical issues became the responsibility of another product of the 1970s congressional reforms, the Office of Technology Assessment (OTA). During the 1972 House debates that contributed to the creation of OTA, Republican Representative Charles Mosher of Ohio, the ranking minority member on the Science, Research & Development subcommittee, made this clear, concise statement regarding the need for such an organization:

> Let us face it Mr. Chairman, we in the Congress are constantly outmanned and outgunned by the expertise of the executive agencies. We desperately need a stronger source of professional advice and information, more immediately and entirely responsible to us and responsive to the demands of our own committees, in order to more nearly match those resources in the executive agencies.[16]

Reports from OTA consolidated inputs from the expert community and presented options and analysis in language designed to be helpful to the policy process.[17] Although its mandate included the full range of technology issues, OTA directed a substantial amount of effort to space issues: 35 reports in its last 15 years (see Appendix B). With approximately 100 staff members in its later years, OTA was a small fraction of the size of other congressional support agencies. But its output (approximately 750 reports in 23 years) made it appear larger thanks to substantial input from teams of outside experts under contract. Unfortunately, OTA became the target of symbolic budget-cutting and it was defunded after September 1995.

In the years since the demise of OTA, the importance of science and technology to policymaking has continued to grow. Many stakeholders have asked whether OTA, or something like it, should be reinstated, and for some—including congressmembers who submitted legislation to that effect—the answer is a resounding yes. More than a decade ago, a senior fellow with the Center for Strategic & International Studies (CSIS) maintained that "[t]he argument to restart OTA is overwhelming" and "the arguments against restarting OTA are weak." Citing endorsements from the American Association for the Advancement of Science and the journal *Foreign Affairs*, he pointed out that OTA reports delivered rich context that continued to provide value years after the reports were published. Such a service yields far more than staffers' efforts to pose a question to a scientist or conduct an Internet search.[18]

More recently, there has been recognition within Congress for the need to recreate a consolidating mechanism to package technology information for decisionmakers. Two analysts from the Brookings Institution summarize it as follows:

> This July [2019], the House Select Committee on the Modernization of Congress gave a unanimous, bipartisan endorsement to reestablish OTA, suggesting the Congressional Technology & Innovation Lab (CTIL) as a new name. In September, a House bill outlined a modified OTA, renamed the Congressional Office of Technology (COT). A November report commissioned by Congress recommended an Office of the Congressional S&T Advisor (OCSTA). And in December, the House Science committee invited experts to weigh in on it all. Congress is no longer just debating whether

> support is needed – but what form that support should take.[19]

In the words of Chairman Beyer in his May 2021 interview, there is "quite a bit of appetite" in Congress for reestablishing OTA.

> I think it's pretty clear that as technologically dependent as we were in 1995, we are much more so. Bringing back the Office of Technology Assessment would be a great idea. I'm not aware that anyone has actually introduced legislation this year to do that. I would be astonished if it doesn't get introduced sometime this calendar year.[20]

Space is just one of the major areas that would benefit from a trusted, in-depth, in-house technology research service dedicated to the needs of congressional committees and members. Public availability of the organization's output also would be beneficial to a broad array of interested parties outside the U.S. government. This includes the attentive public, whose need to know continually increases as technology touches more deeply into their lives.

Despite this continuing interest, OTA reestablishment is not currently on the congressional agenda, and support for its revival is not universal. The current authorization practitioners interviewed for this paper were not particularly enthusiastic about OTA 2.0. Although some felt that it could be useful if available, others thought that existing information sources are sufficient and inputs are being adequately assimilated. Perhaps the lack of enthusiasm is driven by the array of questions that would need to be resolved regarding a new organization: What level of staffing and resources would be required? Who would get to determine the research agenda? Could partisan influences be mitigated? Would research products be delivered quickly enough to be useful in the policy formulation and budgeting process? (All of these concerns played a role in OTA's demise in 1995.)

The Only Constant is Change

Efforts to address the potential future demands of civil and commercial space policymaking and oversight in the U.S. Congress would be well served by looking back at the early history of such activities, examining how we got to where we are today, and speculating on alternative courses of action. It is possible that in the next generation, space could be elevated to a level of political salience even greater than that of the Apollo era. U.S. government investment and involvement, aimed at advancing national interests in science, technology, and economic development, could compel Congress to give far more attention and resources to civil and commercial space issues. This could include full committee status for space in both chambers or a proliferation of space-related committees throughout Congress, accompanied by a quest for better technical advice through a new organization similar to OTA. The pace at which this may happen will be driven by many factors, both domestic and international.

Appendix A
Space Committee/Subcommittee Jurisdictions

117th Congress – 2021	85th Congress – 1958
Senate Committee on Commerce, Science, and Transportation, Subcommittee on Space and Science The Subcommittee on Space and Science has jurisdiction over national and civil space policy; legislation and oversight of science, technology, engineering, and math research, development, and policy; and standards and measurement. The subcommittee conducts oversight on the National Aeronautics and Space Administration (NASA), the Federal Aviation Administration (FAA) Office of Commercial Space Transportation, the Department of Commerce Office of Space Commerce, the National Institute of Standards and Technology (NIST), the National Space Council, the National Science Foundation (NSF), the White House Office of Science and Technology Policy (OSTP), and the United States Arctic Research Commission.[21] Note: In the 116th Congress, the jurisdiction of the former Subcommittee on Aviation and Space also included aeronautical R&D, aviation safety, and the civil aviation responsibilities of the Department of Transportation.	**Senate Committee on Aeronautical and Space Sciences** ◆ Aeronautical and space activities, as that term is defined in the National Aeronautics and Space Act of 1958, except those which are peculiar to or primarily associated with the development of weapons systems or military operations ◆ Matters relating generally to the scientific aspects of such aeronautical and space activities, except those which are peculiar to or primarily associated with the development of weapons systems or military operations ◆ National Aeronautics and Space Administration[22]

117th Congress – 2021	85th Congress – 1958
House Committee on Science, Space, & Technology, Subcommittee on Space and Aeronautics The Subcommittee on Space shall have jurisdiction over the following subject matters: All matters relating to astronautical and aeronautical research and development; National space policy, including access to space; Sub-orbital access and applications; National Aeronautics and Space Administration and its contractor and government operated labs; Space commercialization, including commercial space activities relating to the Department of Transportation and the Department of Commerce; Exploration and use of outer space; International space cooperation; The National Space Council; Space applications, space communications and related matters; Earth remote sensing policy; Civil aviation research, development, and demonstration; Research, development, and demonstration programs of the Federal Aviation Administration; Space law; Other appropriate matters as referred by the Chairwoman; and relevant oversight.[23]	**House Committee on Science and Astronautics** ◆ Astronautical research and development, including resources, personnel, equipment, and facilities ◆ Bureau of Standards, standardization of weights and measures, and the metric system ◆ National Aeronautics and Space Administration ◆ National Aeronautics and Space Council ◆ National Science Foundation ◆ Outer space, including exploration and control thereof ◆ Science scholarships ◆ Scientific research and development[24]

Appendix B
Office of Technology Assessment (OTA) Space Reports
(Not including related topics such as communications and climate change)

1. Solar Power Satellites (August 1981)
2. Civilian Space Policy and Applications (June 1982)
3. Space Science Research in the United States (September 1982)
4. UNISPACE '82: A Context for International Cooperation and Competition (March 1983)
5. SALYUT: Soviet Steps Toward Permanent Human Presence in Space (December 1983)
6. Remote Sensing and the Private Sector: Issues for Discussion (March 1984)
7. Directed Energy Missile Defense in Space (April 1984)
8. Arms Control in Space (May 1984)
9. Civilian Space Stations and the U.S. Future in Space (November 1984)
10. International Cooperation and Competition in Civilian Space Activities (June 1985)
11. U.S.-Soviet Cooperation in Space (July 1985)
12. Anti-Satellite Weapons, Countermeasures, and Arms Control (September 1985)
13. Ballistic Missile Defense Technologies (September 1985)
14. Space Stations and the Law: Selected Legal Issues (August 1986)
15. Commercial Newsgathering From Space (May 1987)
16. SDI: Technology, Survivability, and Software (May 1988)
17. Launch Options for the Future: A Buyer's Guide (July 1988)
18. Reducing Launch Operation Costs: New Technologies and Practices (September 1988)
19. Big Dumb Boosters: A Low-Cost Space Transportation Option? (February 1989)
20. Round Trip to Orbit: Human Spaceflight Alternatives (August 1989)
21. Affordable Spacecraft: Design and Launch Alternatives (January 1990)
22. Access to Space: The Future of U.S. Space Transportation Systems (April 1990)

23. Orbiting Debris: A Space Environmental Problem (October 1990)
24. Exploring the Moon and Mars: Choices for the Nation (July 1991)
25. NASA's Office of Space Science and Applications: Process, Priorities and Goals (January 1992)
26. Remotely Sensed Data From Space: Distribution, Pricing, and Applications (July 1992)
27. Data Format Standards for Civilian Remote Sensing Satellites (May 1993)
28. The Future of Remote Sensing From Space: Civilian Satellite Systems and Applications (July 1993)
29. Global Change Research and NASA's Earth Observing System (November 1993)
30. Civilian Satellite Remote Sensing: A Strategic Approach (September 1994)
31. Remotely Sensed Data: Technology, Management and Markets (September 1994)
32. U.S.-Russian Cooperation in Space (April 1995)
33. The National Space Transportation Policy: Issues for Congress (May 1995)
34. Reducing the Costs of Collecting Meteorological Data: A Workshop Summary (June 1995)
35. The Lower Tiers of the Space Transportation Industrial Base (August 1995)

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[6] U.S. Senate Committee on Commerce, Science, & Transportation, Subcommittee on Space & Science (https://www.commerce.senate.gov/space-and-science-subcommittee).

[7] Space and Aeronautics (117th Congress) Subcommittee Jurisdiction (https://science.house.gov/subcommittees/space-117th-congress)

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[20] Beyer interview, 2021.

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[22] Hechler, p. 14.

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