Broadband

C+

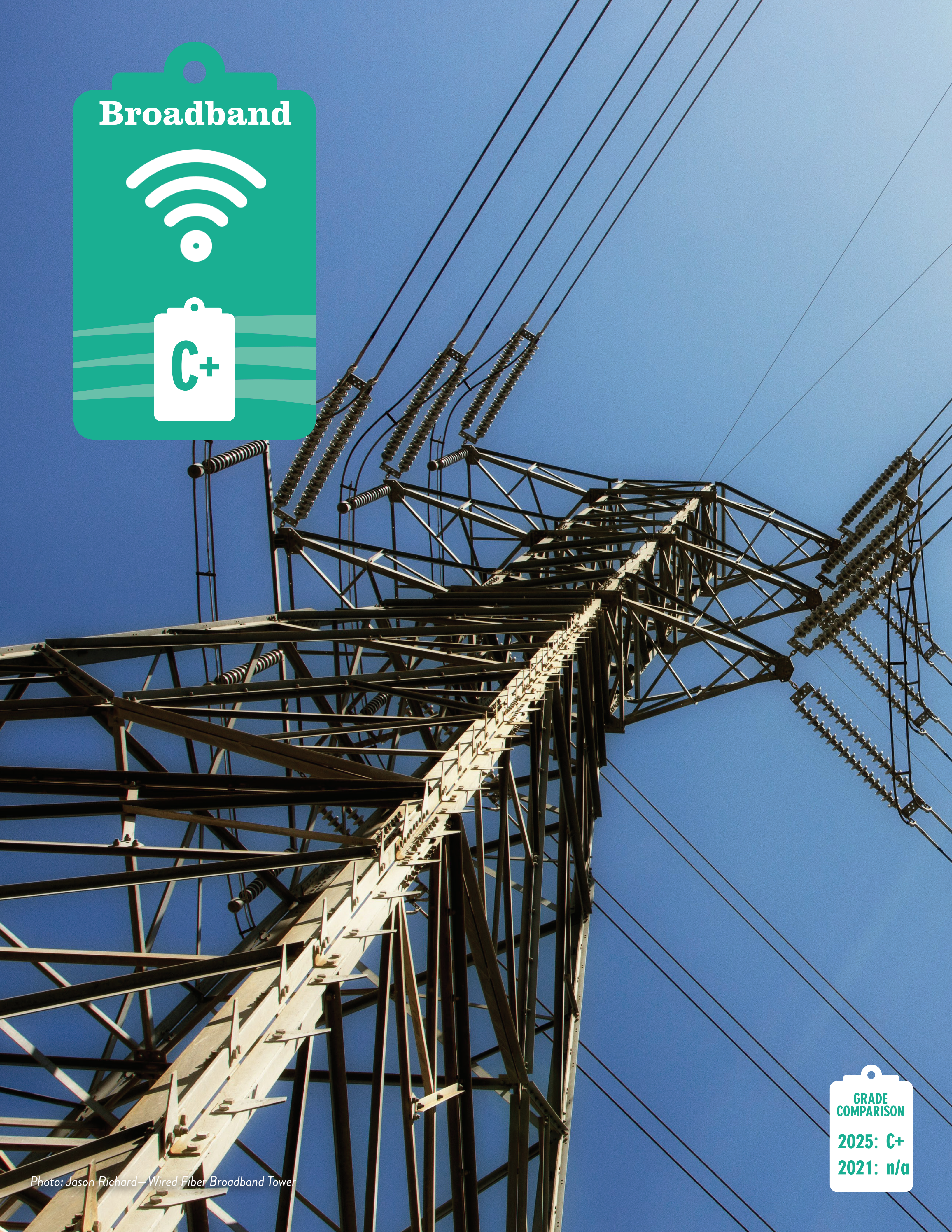

Photo: Jason Richard – Wired Fiber Broadband Tower

GRADE COMPARISON
2025: C+
2021: n/a

BROADBAND

EXECUTIVE SUMMARY

As the fabric of work, society, and commerce has moved into the digital realm, a fast and reliable connection to the internet has become essential.[1] In 2000, only 1% of U.S. adults had broadband access at home, compared to 80% today.[2] America's economy requires reliable broadband access, with research showing that the nation would have lost $1.3 trillion in economic growth between 2010 and 2020 if broadband speeds and adoption had remained at 2010 levels.[3] While the total amount of public spending on broadband is difficult to estimate, the private sector has invested approximately $2.2 trillion in broadband infrastructure since 1996, with the Infrastructure Investment and Jobs Act (IIJA) recently providing an additional $65 billion in federal dollars.[4] Yet, broadband access and adoption continue to face several challenges. Estimates show that 10% of households (12.7 million) do not have a broadband subscription, whether at home or on a mobile device.[5] As new investments are deployed to connect the remainder of Americans to broadband, extreme weather poses challenges to internet reliability and new technologies create a rapidly changing environment.

BACKGROUND

In 2024, 96% of U.S. adults said they used the internet.[6] Almost 3,000 internet service providers (ISP) exist in the U.S., yet the bulk of broadband service is delivered by a few large, private ISPs.[7,8] Homes and businesses connect via wired or wireless connections, with numerous technologies delivering services described under the umbrella term *broadband*. In 2025, the Federal Communications Commission (FCC) defines broadband speed as 100 MBps download and 20 MBps uploads for fixed broadband connections transmitted over any technology. For mobile broadband, the connection provided by cellular networks, the FCC has not adopted a benchmark but is evaluating 5G technologies providing 35 Mbps download and 3 Mbps upload speeds.[9]

The economic impact of broadband investment is considerable. The World Bank estimates that a 10% increase in broadband access can lead to a 1.2% increase in gross domestic product (GDP) per capita in developed countries.[10] Meanwhile, rural areas with broadband adoption rates over 80% receive 213% higher business growth, 44% higher GDP growth, and 18% higher per capita income growth.[11,12] In addition, better broadband access can help improve health and life outcomes, such as improving access to telehealth.[13]

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CAPACITY AND CONDITION

While broadband technologies have been widely adopted over the past two decades, a digital divide remains based on age, income, education, and geography.[14]

The FCC's June 2024 broadband map shows that 94% of U.S. households can access a broadband connection at home that meets the FCC's high-speed internet definition.[15,16] By the FCC's definition, a 1 GB file should take approximately 80 seconds to download, while the upload speed meets the requirements for video web conferencing applications.[17] Availability can vary significantly based on location, with rural and tribal areas often experiencing lower rates of access compared to urban regions. As recently as 2022, the FCC estimated 24 million Americans lacked fixed broadband service, including 28% of those in rural areas and more than 23% living on tribal lands.[18] Furthermore, regardless of the high availability rate, approximately 15% of U.S. adults do not have a home broadband connection for a variety of reasons, including affordability.[19]

The cost of broadband can vary widely. A 2024 survey found that the average monthly internet cost in the U.S. is $62 for a connection with download speeds of 100 MBps, with the price fluctuating from a low of $20 per month to a high of nearly $300 a month based on internet speeds.[20] Additional fees for installation, equipment rental, or other services can add to the cost to access broadband at home.[21] To help consumers understand their costs, the FCC now requires ISPs to provide easy-to-understand pricing labels, modeled after nutrition facts on food items.[22]

Most U.S. households' access to fixed broadband is delivered through fiber-optic cables, copper telephone lines (DSL), or coaxial cables. Coaxial cables, the same lines that carry cable television, are the most widespread wired technology, and an increasing share of households are using wireless technologies.[23]

Broadband Availability and Speed by Connection Type, June 2024

CONNECTION TYPE	CABLE	DSL	FIBER	FIXED WIRELESS	SATELLITE
Point-of-Use Hardware	Coaxial RF Outlet	RJ-11 Phone Jack	RJ-45 Ethernet Connection	Antenna Console	Satellite Dish
Download Speeds (MBps)	10–10,000	5–120	200–20,000	25–300	12–150
Upload Speeds (MBps)	5–50	1–20	200–20,000	1–50	5–25
Nationwide Availability (%)	82	4	46	47	99
Locations Served (million)	134	7	75	77	163
Change from December 2023 (%)	0	−1	+7	+13	0

Source: Information Technology and Innovation Foundation & Federal Communications Commission

Compared to other infrastructure systems, America's broadband networks are often newer and more frequently replaced or augmented with electronic hardware. The oldest copper lines capable of DSL speeds were installed at the dawn of the commercial internet—a relatively recent 35–40 years ago. Coaxial cables followed in the 1990s with the spread of cable television. Today, the most advanced technology being deployed is fiber-optic wiring, with 78 million U.S. homes connected to fiber, totaling 5.1 million miles of wiring, with another 4.2 million miles expected to be added by 2028.[24] Fiber-to-the-home or hybrid systems often replace older systems, with the oldest fiber lines only a few decades old, suggesting that the physical broadband infrastructure is likely in fair condition.

Broadband technologies differ in their deployment costs depending on factors such as geography or population density, labor costs, property acquisition, rights-of-way permissions, permitting, and other regulatory compliance factors, as well as preparation work in design and engineering.[25] For example, wireless technologies are often more financially viable in less dense areas, where the cost of laying fiber-optic or cable lines to connect relatively few homes can be prohibitive.[26]

Approximate Materials Cost for Last-Mile Broadband Deployment Methods

CONTEXT	METHOD	COST IN 2024 DOLLARS
Buried	Fiber	$2,500 + $5 per foot
	Coaxial	Various
Aerial	Fiber	$200 + $3.50 per foot
All Wired Methods – Hardware + Buildings		$1.5 million
All Wireless Methods – Hardware + Buildings		$200,000 + $75,000 per tower
All Methods – Construction Equipment		$300,000

Source: National Telecommunications and Information Administration, "Costs at-a-Glance: Fiber and Wireless Networks," *2017*

Satellite broadband is also being used in remote areas, but it is frequently an expensive option that is generally slower, subject to data caps, and vulnerable to inclement weather.[27,28] A 2024 study noted that 30% of users of one popular satellite internet provider had experienced an internet outage in the previous 90 days compared to 24% for major fiber providers.[29]

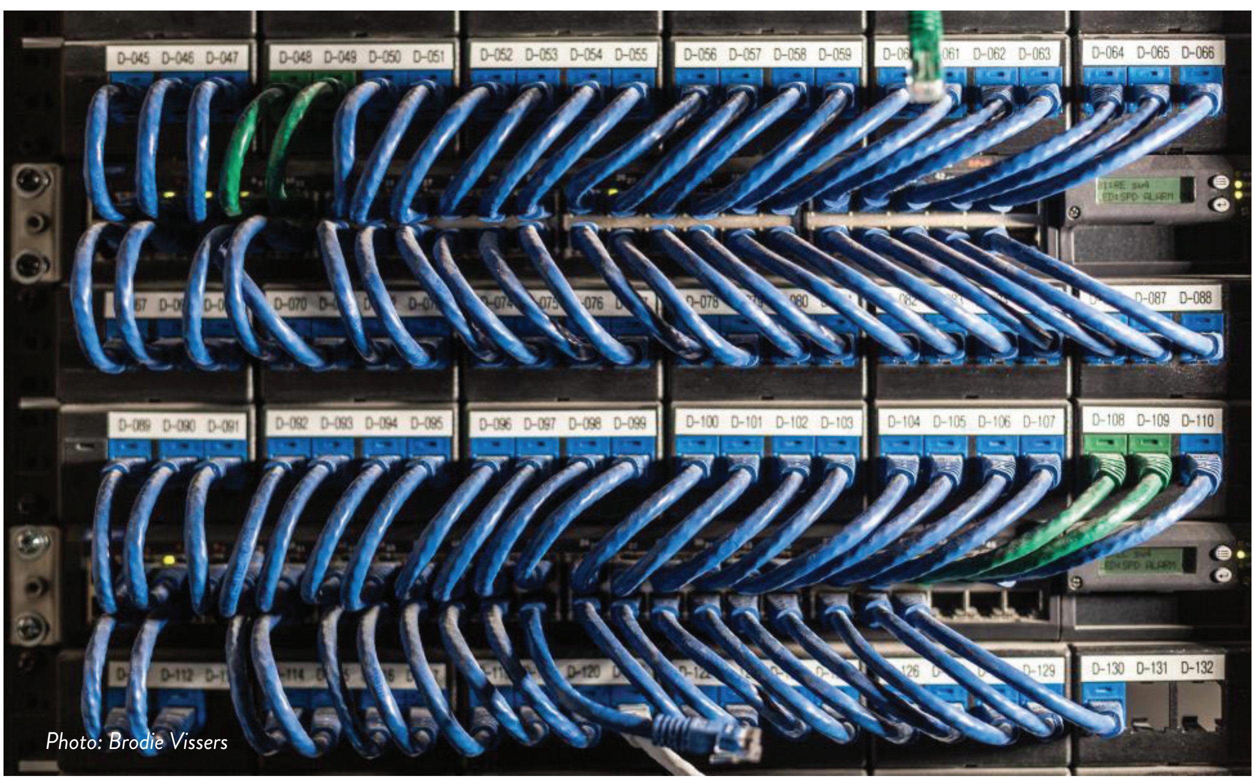


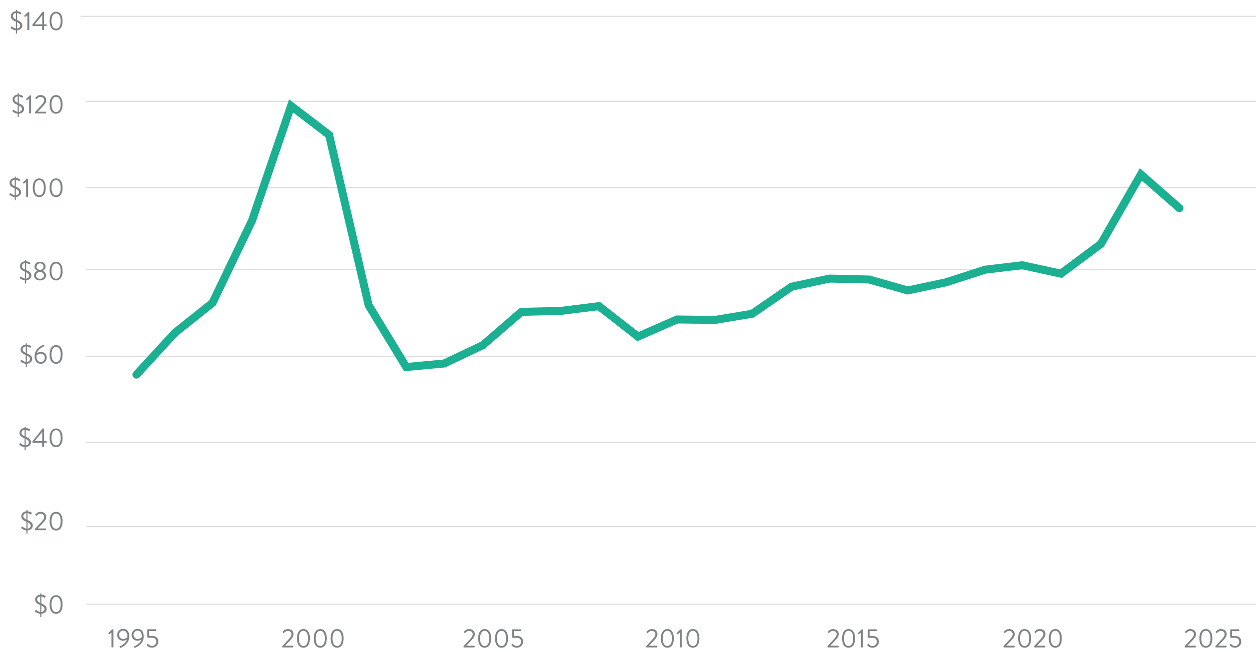
Photo: Brodie Vissers

FUNDING

Some broadband infrastructure in the U.S. is funded by federal, state, and local governments, but private sector ISPs are primarily responsible for building broadband infrastructure and selling internet services to the public.[30] A rising number of municipal broadband networks are administered by local governments, with nearly 450 operating across the country as of January 2024.[31]

Since 1996, ISPs have invested nearly $2.2 trillion in America's broadband infrastructure, and recent federal investments of $65 billion will support continued deployment.[32,33] These federal dollars will be further leveraged by private, state, and local investments; however, that amount is unknown at this time.

U.S. Broadband Provider Capital Expenditures, 1996–2023 ($ Billion)



Source: National Telecommunications and Information Administration

The high cost of deploying broadband infrastructure has historically meant that communities that were more rural, possessed difficult geography, or were otherwise economically less promising struggled to gain access. In response, the FCC, the National Telecommunications and Information Administration (NTIA), and the U.S. Department of Agriculture (USDA) are collaborating to address this inequity. To accelerate the effort, the IIJA allocated $65 billion to improve access to broadband and close the digital divide.[34] Most funding ($42.5 billion) was directed to the NTIA's Broadband Equity, Access, and Deployment (BEAD) Program to expand high-speed internet access through planning, deployment, and adoption programs.[35] As of 2024, the NTIA has begun final approval of projects that qualify for BEAD funding.[36]

The second largest tranche of IIJA funding included $14.2 billion for the FCC to administer the Affordable Connectivity Program (ACP), which modified and replaced the Emergency Broadband Benefit Program.[37] The ACP provided a discount up to $30/month toward internet service for eligible households and up to $75/month for households on qualifying tribal lands.[38] From the program's launch in December 2021 until its funding ran out in June 2024, 23 million households enrolled in the ACP.[39]

FUTURE NEED

It is estimated that it will cost $61 billion to meet the BEAD program's stated goal of universal broadband availability for every American by 2030,[40] with federal capital investments estimated to total $42.5 billion over that same period.[41] Therefore, if current funding levels continue, the nation is well poised to meet today's needs. However, deployment costs are increasing, with some firms seeing costs increase by over 10% for deployment, with materials and labor costs being the largest drivers for the increase.[42,43]

As faster internet technologies are developed, users are simultaneously consuming larger amounts of data, especially related to video. The average monthly broadband consumption per household has more than doubled over the past five years from 276 GB in the fourth quarter of 2018 to 641 GB by the fourth quarter of 2023.[44] As recently as 2010, the average consumer used only 9 GB of data per month.[45] At the current rate of growth, it is estimated the average household will consume more than 1 TB of data per month by 2028.[46] To meet the growing and future demands of the digital world, investments are needed to develop and expand broadband infrastructure.

Recent federal mandates have also affected the installation and operation costs of broadband networks. Two of the most consequential federal provisions are "Rip and Replace" and "Build America, Buy America."

Since 2019, ISPs have been required to remove telecommunications equipment the FCC deems could pose national security risks.[47] This "Rip and Replace," mandate has led to operational challenges and financial burdens for ISPs, particularly smaller providers that previously relied on affordable Chinese equipment. The cost of replacing this equipment can be substantial, and while the federal government has provided some funding to offset these costs, the process has been complex and time-consuming. As of 2024, some ISPs are still in the process of replacing their equipment, and the FCC has highlighted the need for additional funding for the replacement reimbursement program.[48]

Next, the IIJA includes a requirement to source equipment, supplies, and labor from within the U.S. to boost domestic manufacturing. In the case of broadband, many of the requisite components are not currently produced in America. This requirement has added complexity and potentially significant cost increases to broadband projects. To address these concerns, NTIA has issued a "nonavailability waiver" to the BEAD program's Build America, Buy America provisions.[49]

Finally, the challenge of meeting America's future broadband needs is compounded by the shortage of qualified workforce. Research estimates that the industry will require an additional 205,000 jobs over the next five years to build, operate, and maintain these networks.[50] Since 2014, the telecommunication workforce has shrunk by 25%, from 848,000 to 633,700.[51] Several states are responding by deploying resources to meet the workforce shortage. Examples include Louisiana's implementation of a broadband workforce development curriculum for community and technical colleges.[52] ISPs in Alaska also work with unions and trade associations to support telecom apprenticeship programs that consist of classroom and on-the-job training.[53]

*Photo: Gordon Chaffin—
Spliced Fiber Broadband Cable*

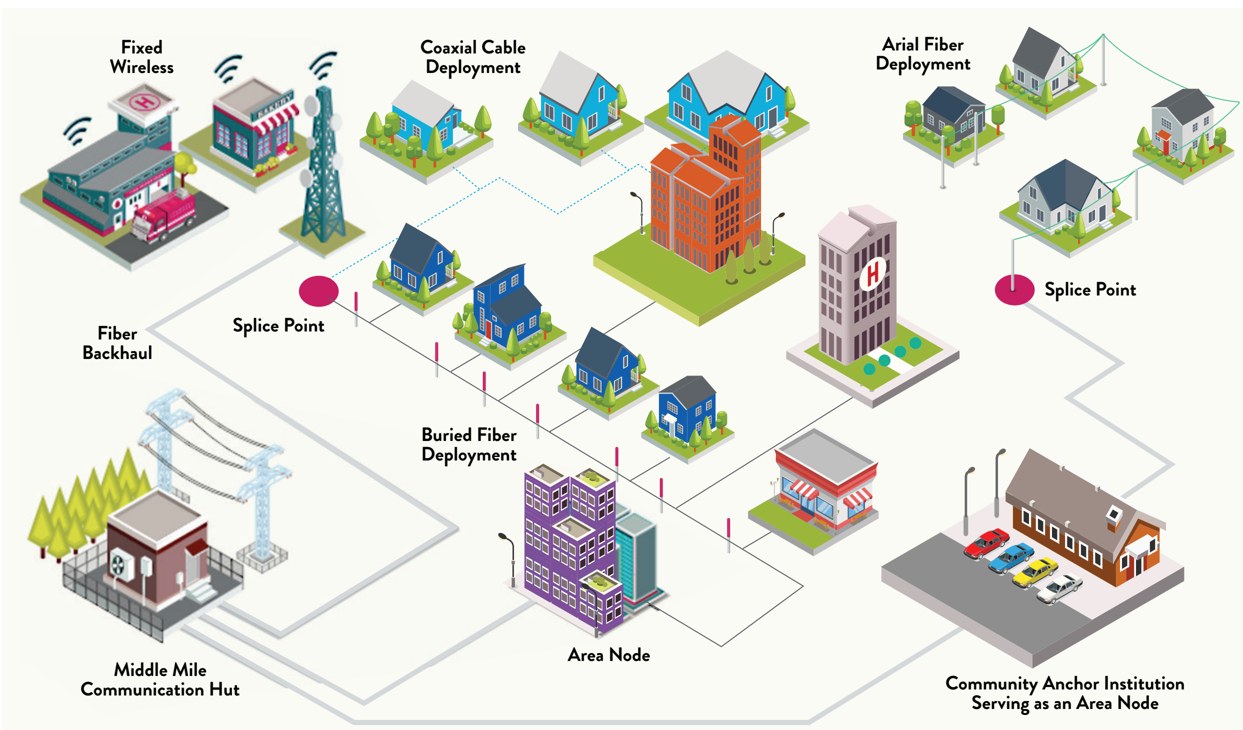
OPERATION AND MAINTENANCE

Depending on the technology deployed, the cost to operate and maintain broadband networks can vary greatly, with fiber-to-home networks generally the most cost-effective method to operate, costing $53 a year per home passed (PHP) versus $107 PHP for hybrid fiber coax and $144 PHP for DSL networks.[54]

Although fiber may be the most cost-effective form of broadband to operate and maintain, it remains the most expensive technology to deploy, with highly variable capital costs depending on geography, density, and the built environment.[55] For example, digging trenches to lay underground fiber-optic cables can be costly and time-intensive, especially when connections are made across rural locations. Distances between settled areas require more miles of fiber-optic cable to connect fewer residences or businesses, and mountainous areas may be cost-intensive if rock drilling is required. The cost of additional fiber deployment can also change if the installed lines are aerial versus underground. In response, fixed wireless service is a fast-growing deployment method, because overall costs are lower in those challenging geographies.

Finally, as networks age, cables and equipment must be maintained or replaced as they fail or reach the end of their life.[56]

Broadband Network Scenarios by Deployment Type



Source: National Telecommunications and Information Administration, "Broadband Network Deployment Engineering," *2022*

PUBLIC SAFETY

The nation's broadband infrastructure provides a target for bad actors looking to damage and disrupt businesses, services, and the economy. For example, in November 2024, Chinese hackers breached at least eight U.S. telecommunications providers and stole customer call and law enforcement surveillance request data. These sorts of data breaches are estimated to cost $4.9 million per impacted organization globally.[57]

Beyond the continued threat of cyber security incidents, public safety depends on the continued operation of broadband during emergencies. When power goes out, so does the last mile of internet infrastructure. Emergency response has been digitized over recent years, meaning first responders have better information to do their jobs, but broadband up-time is more crucial than ever.

Recognizing these challenges, in 2012 Congress created the First Responder Network Authority (First Net). Since 2017, the program has been provided $7 billion to build, deploy, and operate a dedicated nationwide public safety broadband network for use by America's first responders. As of 2024, 29,000 public safety agencies are supported by FirstNet with approximately 6.4 million connections.[58] However, the completion of the dedicated network will require billions more in government funding over the coming years.

Finally, key pieces of physical infrastructure depend on internet-connected sensors. In extreme events, information flow from dam load sensors or a stormwater flow gauge, for example, is essential. These infrastructure components are vulnerable to cyber security threats, as shown in 2024 when water and wastewater facilities were targeted.[59] Operators of key infrastructure face competing priorities, so improving cybersecurity practices is often constrained by limited resources.

RESILIENCE AND INNOVATION

Severe weather and other natural disasters can disrupt or disable critical broadband infrastructure. Broadband infrastructure must be built to withstand more frequent extreme weather events, such as increased precipitation, threatening temperatures, high humidity, and rising sea levels across its service life.[60] To meet the threats

FEDERAL MONEY BOOSTS LONGSTANDING BROADBAND WORK IN WISCONSIN

Wisconsin is improving its broadband infrastructure with at least $1 billion in new federal investments from the 2021 IIJA. Since 2014, the Wisconsin Broadband Office has distributed $319 million in grants to deploy broadband infrastructure. Funding has supported 458 projects through new and/or enhanced services to approximately 450,000 homes in the state. Housed within the state's Public Service Commission, Wisconsin's Broadband Office has more extensive data collection abilities than many other states, so decision-makers and the public can better perform oversight and identify investment needs from the private and public sectors. Currently, 32% of Wisconsin locations have access to fiber connections, all of which are broadband speed. But of those connected via cable, 31% do not receive benchmark speed, and fixed wireless only delivers broadband speeds to 14% of Wisconsin residents. Satellite services are usually also available to those same residents, but 98% of low earth orbit connections do not meet the current FCC broadband standard. To connect all Wisconsin locations to broadband, state leaders estimate it will require $1.2 billion in additional investment beyond existing BEAD funds.

presented by extreme weather, hardened features to withstand specific disasters are vital to the health of these critical systems; these include burying vulnerable fiber-optic lines and reinforcing towers. Creating redundant systems, like backup batteries and power generators, help build a more resilient network to handle the rise in extreme weather.[61]

The benefits of investments in resiliency have not been lost on policymakers. The BEAD Program requires states and territories to assess the risks posed by climate-related disasters in their area. In turn, states have created strategies to mitigate risk and increase the resilience of broadband infrastructure.[62] For example, in its draft proposal to the NTIA in December 2023, North Carolina proposed requiring its subgrantees to submit an approved Climate Resiliency Plan, along with an explanation of how the plan factors into a project's total cost.[63] In Louisiana, applicants must estimate the cost of burying fiber-optic cable and incentivize projects that bury at least 90% of new fiber, while California requires project proposals in vulnerable areas to install a 72-hour backup power supply to meet its resiliency standards.[64]

As resiliency improves among broadband infrastructure, government and industry are using broadband to innovate and better connect to more traditional infrastructure categories. The growth of the Internet of Things (IoT), networks of devices, sensors, and other objects that collect and exchange information using broadband technologies, is transforming the way key stakeholders monitor, operate, and maintain infrastructure.[65] For example, California's Yuba Water Agency is using this technology to improve its operation and risk assessment of the New Bullards Bar Dam, the fifth tallest dam in the U.S.[66] Similarly, the city and county of Denver is using IoT sensors to monitor and improve the operation and maintenance of its Highland Bridge, a vital pedestrian bridge in the heart of the city.[67]

Photo: This is Engineering - Farm Robot with Internet

Broadband

C+

RECOMMENDATIONS TO RAISE THE GRADE

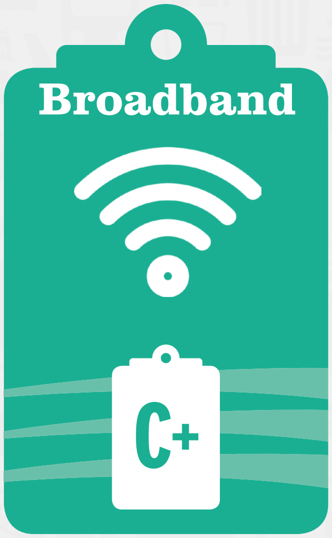
- Incentivize internet service providers to provide better service data for key performance indicators such as delivered speeds and reliability of service.
- Provide dedicated, predictable funding for broadband affordability programs.
- Account for life-cycle costs and possible recovery costs from systems failures when delivering broadband projects.
- Facilitate state-based reporting on the implementation of broadband plans, the use of BEAD, and other federal broadband funding.
- Encourage partnerships with state and local agencies and broadband providers to facilitate service uptake for vulnerable communities.
- Expand Dig Once policies to include broadband deployment plans in more public works projects, specifically transportation, energy, and water improvements that are already requiring work above and below the ground.
- Incentivize the latest up-to-date codes and standards for utility poles and other structures that are often used for broadband deployment.

SOURCES

1. NPR, "30 Years Ago, One Decision Altered the Course of Our Connected World," 2023.
2. Pew Research Center, "Internet, Broadband Fact Sheet," 2024.
3. Telecom Advisory Services, "The Contribution of Fixed Broadband to the Economic Growth of the United States between 2010 and 2020," 2022.
4. USTelecom, "2023 Broadband Capex Report," 2024.
5. U.S. Census Bureau, "Computer and Internet Use in the United States: 2021," 2024.
6. Pew Research Center, "Internet, Broadband Fact Sheet," 2024.
7. Broadband Now, "The Complete List of Internet Companies in the U.S.," 2024.
8. Telecompetitor, "FCC Finds 11 ISPs That Cover 5% or More of the U.S. Population, Number 11 is a Surprise," 2023.
9. Federal Communications Commission, "2024 Section 706 Report," 2024.
10. International Telecommunications Union, "Impact of Broadband on the Economy," 2012.
11. Center on Rural Innovation, "Beyond Connectivity: The Role of Broadband in Rural Economic Growth and Resilience," 2024.
12. Federal Reserve Bank of Richmond, "Topics: Broadband," 2024.
13. Brookings Institute, "Digital Prosperity: How Broadband Can Deliver Health and Equity to All Communities," 2020.
14. U.S. Census, American Community Survey, "S2801: Types of Computers and Internet Subscriptions," 2023.
15. Federal Communications Commission, "FCC National Broadband Map," 2024.
16. Federal Communications Commission, "2024 Section 706 Report," 2024.

SOURCES (cont.)

17. CNET, "What's Up With the Upload Speeds? Here's All You Need to Know," 2024.
18. Route Fifty, "New FCC Broadband Standard Increases the Number of 'Underserved' Households in America," 2024.
19. Pew Research Center, "Americans' Use of Mobile Technology and Home Broadband," 2024.
20. Forbes, "How Much Does Internet Cost Per Month?," 2024.
21. Ibid.
22. Federal Communications Commission, "Broadband Consumer Labels," 2024.
23. Information Technology & Innovation Foundation, "The State of US Broadband in 2022: Reassessing the Whole Picture," 2024.
24. Fiber Broadband Association, "Fiber Expected to Add 23.2 Million U.S. Homes Passed by 2028," 2024.
25. National Telecommunications and Information Administration, "Costs at-a-Glance: Fiber and Wireless Networks," 2017.
26. Information Technology & Innovation Foundation, "The State of US Broadband in 2022: Reassessing the Whole Picture," 2024.
27. Forbes, "Satellite Internet Explained: How Does It Work and Is It Right for You?," 2024.
28. Broadband Now, "What Is Satellite Internet? Pros, Cons, and Terminology," 2024.
29. Light Reading, "Starlink Subs Report Seeing Fewer Outages Than Cable – Study," 2024.
30. Congressional Research Service, "Federal Funding for Broadband Deployment: Agencies and Considerations for Congress," 2023.
31. Fierce Network, "The U.S. Now Has Nearly 450 Municipal Broadband Networks," 2024.
32. USTelecom, "2023 Broadband Capex Report," 2024.
33. Fiber Broadband Association, "The State of Fiber – North America," 2024.
34. Brookings Institute, "Why the Federal Government Needs to Step Up Efforts to Close the Rural Broadband Divide," 2022.
35. National Telecommunications and Information Administration, Internet For All, "Programs: Overview," 2024.
36. National Telecommunications and Information Administration, Internet For All, "BEAD Progress Dashboard," 2024.
37. Federal Communications Commission, "Telecommunications Access Policy Division: Affordable Connectivity Program," 2024.
38. Ibid.
39. Federal Communications Commission, "Affordable Connectivity Program (ACP) Fact Sheet," 2024.
40. Fiber Broadband Association, "The State of Fiber – North America," 2024.
41. Fiber Broadband Association, Cartesian, "Fiber Deployment Annual Report," 2023.
42. Race Communications, "Which Materials Can Be Used to Make Fiber Optic Strands?," 2024.
43. Fierce Network, "U.S. Broadband Consumption Climbs as 'Power Users' Proliferate," 2024.



SOURCES (cont.)

44. Fierce Network, "U.S. Broadband Consumption Climbs as 'Power Users' Proliferate," 2024.
45. AllConnect "Report: The Average Household's Internet Data Usage Has Jumped 38x in 10 Years," 2020.
46. Allconnect, "Report: Internet Users Are Gobbling Data by More Than a Half-Terabyte," 2024.
47. 116th U.S. Congress, "H.R. 4998 - Secure and Trusted Communications Networks Act of 2019," 2020.
48. Federal Communications Commission, "Letter to U.S. Senator Maria Cantwell: Secure and Trusted Communications Networks Act," 2024.
49. U.S. Department of Commerce, "Limited General Applicability Nonavailability Waiver of the Buy America Domestic Content ... as Applied to Recipients of [BEAD]," 2024.
50. Fiber Broadband Association, Cartesian, "Broadband Workforce Development Guidebook," 2023.
51. U.S. Bureau of Labor Statistics, "TCES5051700001: Telecommunications Industry Report," 2025.
52. Fierce Network, "Here's How States Are Tackling the Broadband Workforce Gap," 2023.
53. Business Wire, "Alaska Telecommunications Leaders Partner to Encourage Alaskans to Consider Telecom Careers," 2024.
54. Fiber Broadband Association, "Operational Expenses for All-Fiber Networks are Far Lower Than for Other Access Networks," 2020.
55. National Telecommunications and Information Administration, "Costs at-a-Glance: Fiber and Wireless Networks," 2017.
56. CostQuest, "Calculating Network Cost," 2021.
57. Center for Strategic & International Studies, "Significant Cyber Incidents," 2025.
58. FirstNet, "FirstNet: By the Numbers," 2024.
59. Office of the U.S. Director of National Intelligence, "Recent Cyber Attacks on US Infrastructure Underscore Vulnerability of Critical US Systems, November 2023–April 2024," 2024.
60. New York Dept of Environmental Conservation, "Climate Change Considerations in Broadband Network Development," 2023.
61. Pew Charitable Trusts, "Letter to State Broadband Offices: Climate Resilience Memo," 2023.
62. Center for Rural Innovation, "BEAD Broadband Funding Guide: Environmental/Climate Hazard Mitigation," 2025.
63. North Carolina Department of Information Technology, "Initial Proposal; North Carolina, Volume 2," 2023.
64. Center on Rural Innovation, "BEAD Broadband Funding Guide: Environmental/Climate Hazard Mitigation," 2025.
65. TechTarget, "Internet of Things," 2025.
66. IoTNOW, "IoT and Digital Twins Drive Bridge and Dam Safety in Real-Time," 2023.
67. Mass Transit Magazine, "Digital Transformation Drives Innovation in Transportation," 2023.