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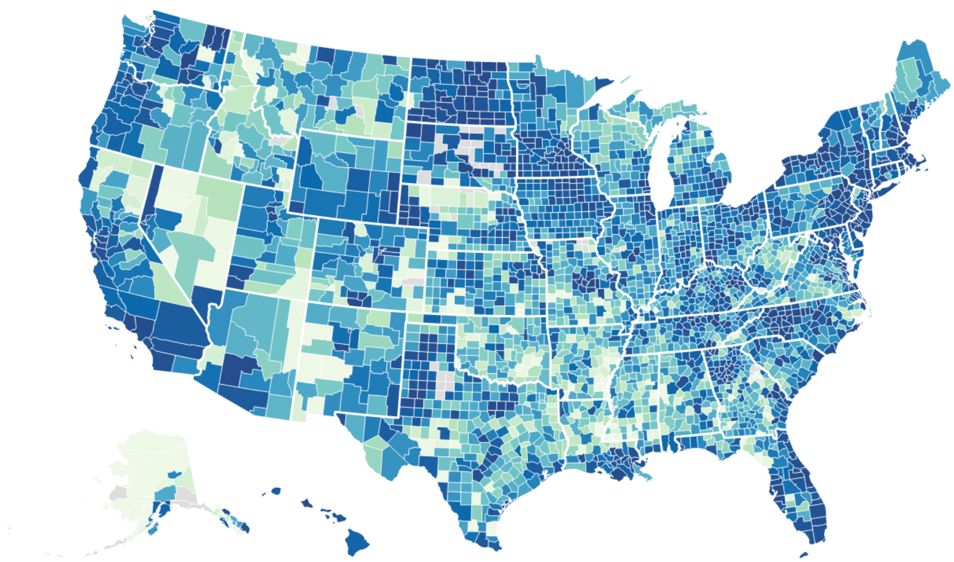
Broadband Policy Guidebook, 2022 Edition



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Broadband Policy Guidebook, 2022 Edition

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Connectivity is a driver of economic growth, particularly in times of remote learning, remote work, and economic recovery. Billions of dollars of federal funds are being distributed to state governments and federal programs to subsidize broadband projects. The *Broadband Policy Guidebook, 2022 Edition* is a guide for state and federal policymakers to understand the economic research and policy lessons of broadband programs. In this Guidebook, the economists of the Technology Policy Institute bring decades of experience in government and economic research to educate state, local, and federal policymakers on broadband policy.[1]

1 Executive Summary

Federal, state, and local policymakers are tasked with distributing billions of dollars of infrastructure funds for broadband connectivity. This Guidebook offers a roadmap through dozens of policy questions and lessons learned from federal and state broadband programs that have been funded and implemented over the last several decades.

Several core recommendations emerge from this history of broadband policymaking.

Recommendations:

- *Rely on evidence* from a long history of telecommunications policies and regulations, admitting what we know and what we do not yet know about the effects and effectiveness of subsidies.
- *Acknowledge trade-offs*. Some goals may be inconsistent with others.
- *Create a coherent weighting system to compare proposals*. Ideally, weights are based on how much consumers value various aspects of broadband.
- *Rely on state procurement expertise*. Like other state procurements, use competitive bidding for broadband services in order to require suppliers to compete against each other for contracts.
- *Build evaluation into any program*. The key to program evaluation is transparency, such as making all proposals public whether they are funded or not.
- *Work together*. Avoid duplicative efforts across states, and seek economies of scale from joint efforts with other states, federal agencies, and the private sector.

[1] Material in this Guidebook has been published in other documents such as *Comments to the NTIA, In re: Infrastructure Investment and Jobs Act Implementation*, Docket No. 220105–0002, Feb. 4, 2022, https://techpolicyinstitute.org/wp-content/uploads/2022/02/TPI_Comments_to_NTIA_on_BIL.pdf; Scott Wallsten, "Is Broadband a Public Utility? Let's Hope Not," May 21, 2020, *Technology Policy Institute*, https://techpolicyinstitute.org/publications/broadband/is-broadband-a-public-utility-lets-hope-not/.

2 How to Use This Guidebook

This *Broadband Policy Guidebook, 2022 Edition* is meant to provide basic foundations in what we know and what we don't know about government programs related to broadband infrastructure. For those with advanced knowledge of broadband policy, this Guidebook can help identify areas where experts and advocates disagree and where we still need empirical research and experiments.

The answers to policy questions require careful analysis akin to questions in health, education, and environmental policy. To understand broadband connectivity in the United States, we depend on government datasets, private datasets, and annual reports by state and federal regulators. Interventions and programs of broadband subsidies have varied outcomes, which we catalog here.

A Note about Data

Many discussions in this Guidebook about broadband availability rely on what is known as the Federal Communication Commission's (FCC's) Form 477 data. Internet service providers (ISPs) fill out this form twice per year to provide the FCC with information on their services. The FCC releases data at the census block level. With more than 11 million census blocks across the country, the data is reasonably granular but also widely understood to have some problems. The main problem is that the FCC considers a census block served if an ISP has even only one customer in the block. As a result, Form 477 data overstates availability. It also cannot be used to clearly delineate areas without service. The FCC is working on new data to fix these problems.

Those flaws in Form 477 data, however, do not affect the discussions in this Guidebook. Here, we use the data to look at trends and comparisons. Specific availability statistics generated by Form 477 data—for example, when we say 42% of households have access to broadband speeds of 100 Mbps down and 20 Mbps up—may be somewhat off, but the trends and comparisons and the points they make remain accurate.

3 Defining Broadband

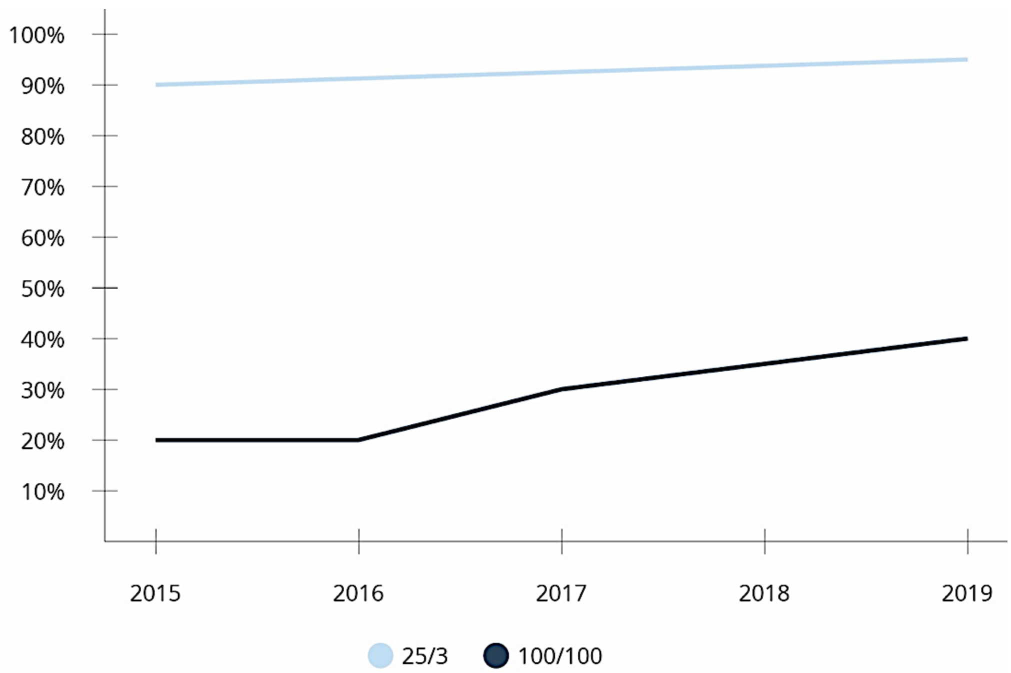
Colloquially, broadband refers to high-speed internet access. Broadband may be delivered over a wired, wireless, fixed, or mobile connection and is usually described—somewhat misleadingly—by download and upload speeds of data that flow to and from the end user. For consumers, no specific speed separates a broadband connection from a not-broadband connection. What matters to consumers is whether they can use the online applications they need or want to use.

For the purpose of policy, the specific definition of broadband has two implications.

First, the threshold set by policymakers affects which areas and which types of services may be eligible to qualify for subsidies. Higher threshold speeds mean fewer areas would be considered served and more areas would be unserved, thus qualifying for subsidies. Assume, for example, that policymakers were considering changing the current definition of 25 Mbps download speed and 3 Mbps upload speed (25/3) to a higher threshold of 100 Mbps download speed and 100 Mbps upload speed (100/100).

At 25/3, more than 90% of households were considered served with access to broadband in 2020. If, instead, broadband is defined at a higher threshold of 100/100, then only 42% of households were considered served (Figure 1).

Figure 1: Share of Households with Access to Broadband under Definitions of Broadband at 25/3 Mbps and 100/100 Mbps as of December 2019



Source: FCC Form 477 data as processed by TPI's Total Broadband Dashboard. Form 477's method of counting providers by census block means these numbers are likely overstated.

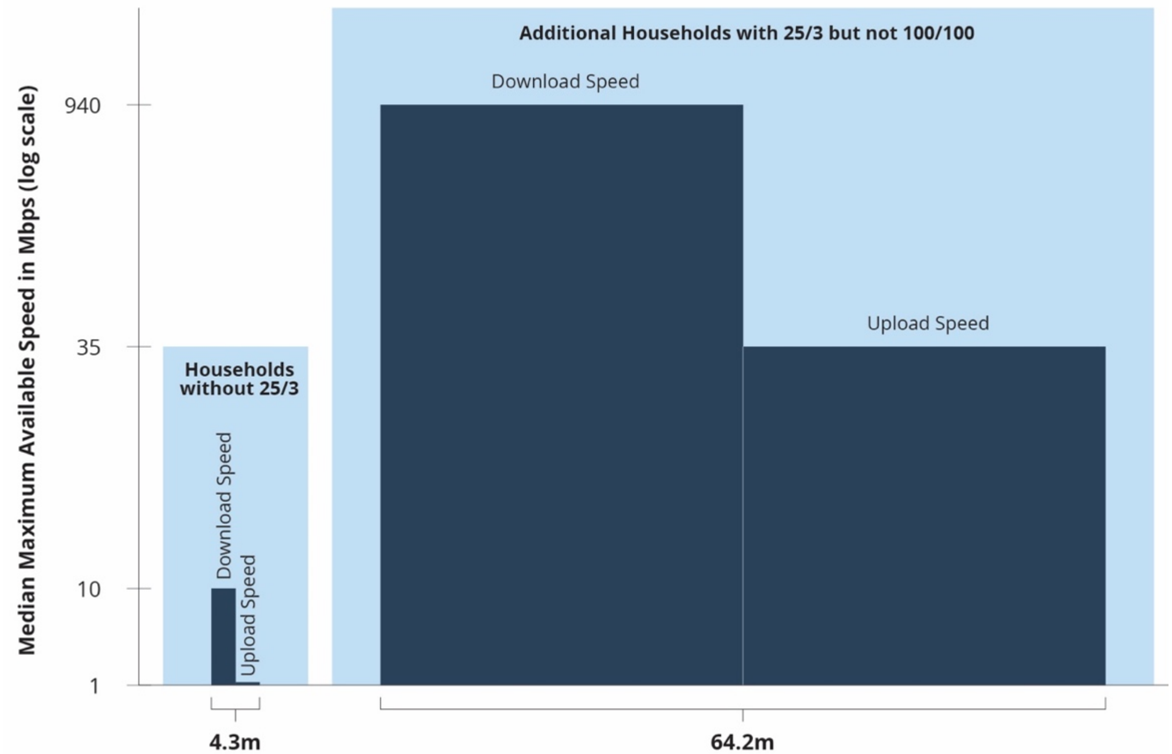
Under a 100/100 definition, households with 90 Mbps download speed and 90 Mbps upload speed available would be considered unserved and would be just as eligible for subsidies as a household with 15 Mbps download speed and 1 Mbps upload speed. Thus, defining the threshold has significant effects on where subsidies go.

At the 25/3 threshold, approximately 4.3 million households do not have access to a broadband connection (excluding satellite). But at 100/100, an additional 64.2 million households lack access to broadband, even though they have access to 25/3.

By changing the threshold definition, the number of unserved households that do not have access to broadband jumps from 4.3 million households to 64.2 million households. Under a 25/3 definition, about 4.3 million households live in areas eligible for subsidies, while under a

100/100 definition, an additional 64.2 million households live in areas that would be considered unserved and eligible for subsidies (Figure 2).

Figure 2: Estimated Number of Households Eligible for Subsidies under Different Definitions of Broadband (25/3 and 100/100)



Source: FCC Form 477 and U.S. Census as processed by TPI's Total Broadband Dashboard. The height of the bars is the population-weighted median maximum available bandwidth, and the width of the bars shows the number of households in that category. Various methods of combining U.S. Census and Form 477 data may yield somewhat different estimates of the number of households in each category.

In order to shrink or expand subsidy programs, policymakers and advocates argue over download and upload speeds rather than focusing on speeds actually required by the applications most people use such as Netflix, Zoom, and web browsing that require modest levels of bandwidth. Table 1 shows the download and upload speeds recommended by some of the most common platforms. Even when multiple people in a household share a broadband connection, a 25 Mbps downstream connection is quite sufficient for modern apps.

To be sure, what we consider broadband for the sake of policy should change over time as technology and demand change. As the supply of Internet services has expanded and demand from household and business activity has increased, the FCC has adjusted the definition over time from 200 Kbps to the current definition of 25 Mbps download speed and 3 Mbps upload speed.

Table 1: FCC Broadband Definition over Time

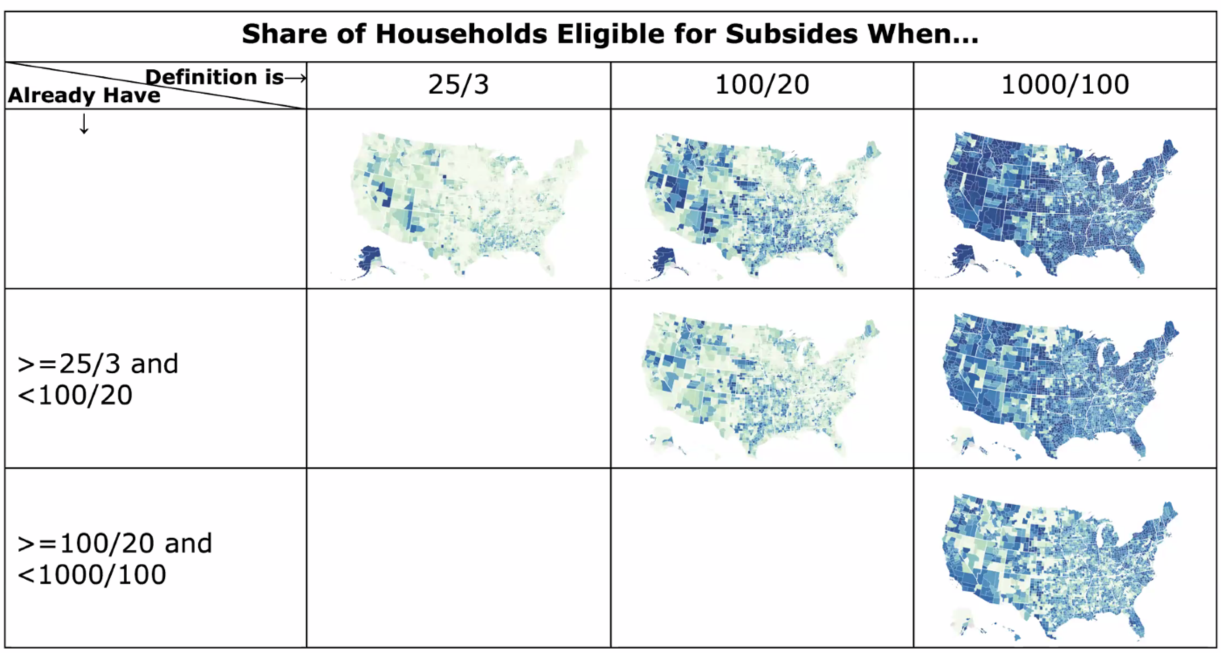
Date Adopted	Minimum Download	Minimum Upload
1996	200 Kbps	200 Kbps
2010	4 Mbps	1 Mbps
2015	25 Mbps	3 Mbps

Source: https://broadbandnow.com/report/fcc-broadband-definition/

A broadband connection of 200 Kbps may have been fine in 1996 but would not be today. Still, a policy definition that runs too far ahead of consumer demand or network supply can distort how subsidies are distributed and reduce consumer welfare.

If the threshold is set too low, policies may miss areas that are underserved for typical consumer use. If the threshold is set too high, areas that already have sufficient connectivity may be eligible to receive subsidies that do nothing to make consumers better off, siphoning money that could have gone to areas that truly lag behind (Figure 3).

Figure 3: Share of Eligible Households under Different Definitions of Broadband

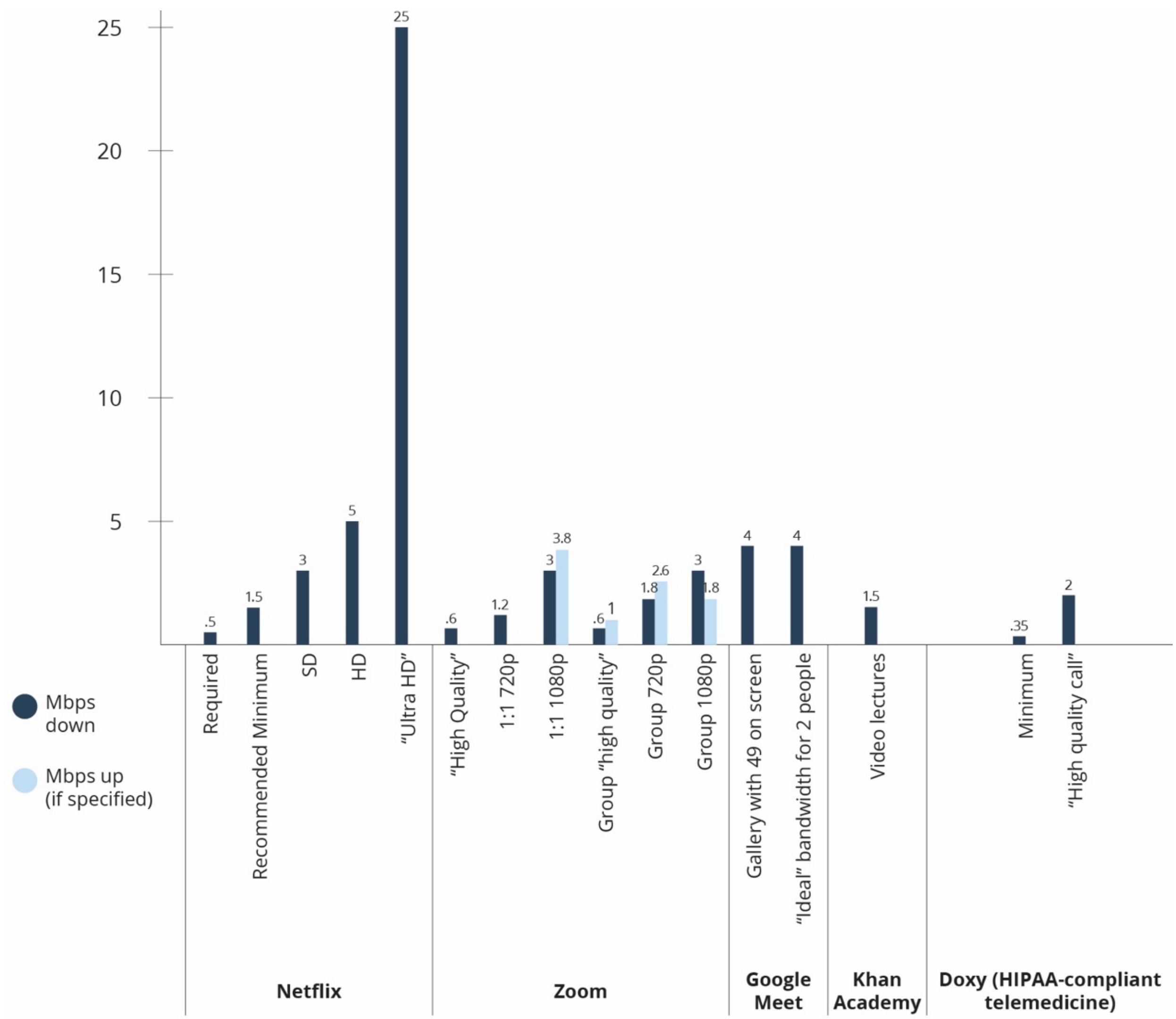


Source: FCC Form 477 and U.S. Census as processed by TPI's Total Broadband Dashboard.

The threshold definitions should not be arbitrary. Instead of defining broadband by arbitrary download and upload speeds, policymakers should consider ways to take into account how people actually use high-speed internet and how much they value incrementally faster speeds in various use cases (Figure 4). Some use cases such as real-time or streaming applications are less sensitive to bandwidth and more dependent on latency. Other use cases are less sensitive to bandwidth due to adaptive bitrate streaming, a technology that streams data efficiently over broadband connections.

Rather than a crude "subsidize everyone who doesn't have 100 Mbps" approach, policymakers should consider what consumers use, how much they value incremental speeds or capabilities, and whether those benefits exceed the costs.

Figure 4: Recommended Bandwidth by Service in Mbps



Sources: Netflix, Zoom, Google Meet, Khan Academy, Doxy.[2]

[2] https://help.netflix.com/en/node/306; https://support.zoom.us/hc/en-us/articles/201362023-System-requirements-for-Windows-macOS-and-Linux; https://support.google.com/meethardware/answer/4541234?hl=en#zippy=%2Cminimum-bandwidth-required; https://support.khanacademy.org/hc/en-us/articles/204795670-What-technology-set-up-and-maintenance-are-recommended-for-organizational-use-#:~:text=Bandwidth%20and%20connectivity&text=Most%20Khan%20Academy%20videos%20require,to%20150%20kbps%20per%20user; https://help.doxy.me/en/articles/3311828-webrtc.

The definition's second implication is that it determines the outcome of an analysis of broadband competition. The higher the threshold speed used to define broadband, the fewer the number of providers that meet or exceed that threshold. In other words, the higher the speeds used to define broadband, the less competitive the market will appear to be, and vice versa.

A competition analysis based on an arbitrary definition is not likely to reflect true competition. A definition that is too weak will overstate competition, and a definition that is too strong will understate it. A full understanding of competition takes into account how substitutable different services are for different types of consumers and would be based heavily on cross-elasticities of demand.

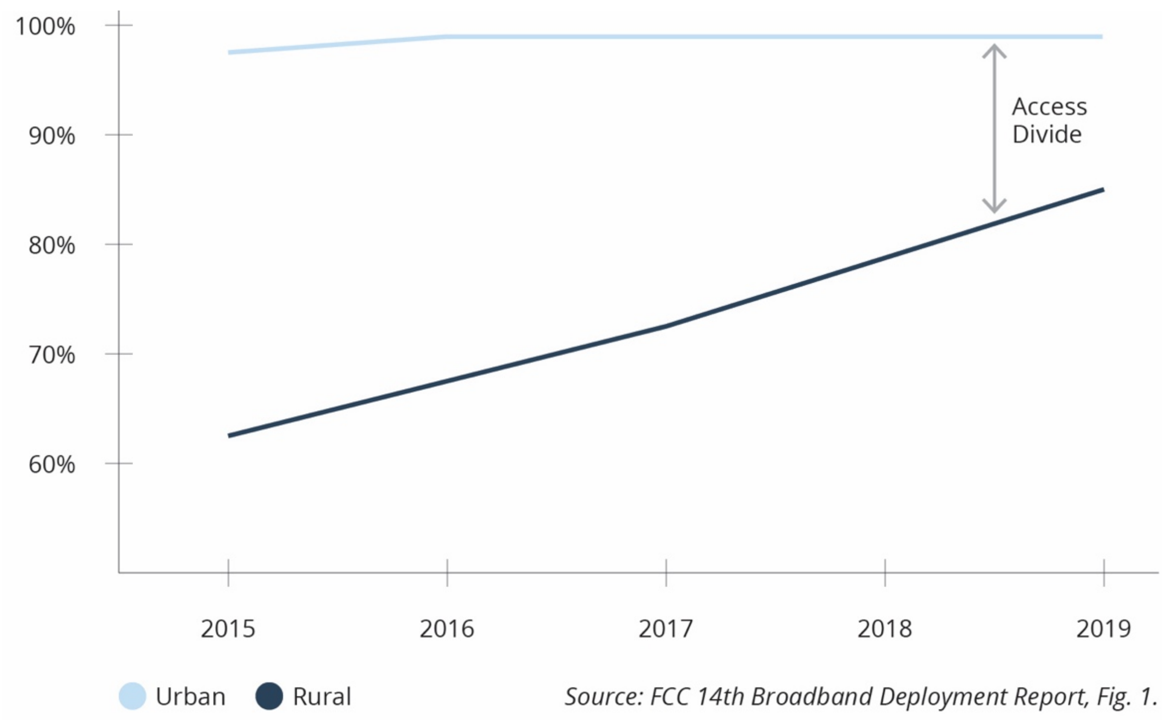
4 Defining the Digital Divide

The digital divide is a catchall phrase for two broader issues—an access divide and an adoption divide—each with complicated components.

4.1 Access

The *access* divide refers to the gap between typically though not solely urban and suburban areas where nearly all households can obtain fast, reliable broadband connections and typically though not solely rural areas where people can obtain only satellite broadband. Figure 5 shows this divide from 2015 through 2019. The access divide has been narrowing, with rural access growing from 60% to more than 80% over those four years. Urban access has remained steady at more than 98%.

Figure 5: Share of Households with Access to Fixed Terrestrial 25/3 Broadband



The gap between urban and rural access is due to the generally higher cost of connecting rural areas. Because lower-cost (all else equal) areas are built out first, reaching the last unconnected households becomes increasingly costly. The FCC tracks broadband deployment in its annual Broadband Deployment Report that focuses on trends in access rates.[3]

4.2 Adoption

The adoption divide refers to differences in broadband subscription rates among demographic groups.

Figure 6 shows the difference in adoption rates by income from household survey data between 2000 and 2020.[4]

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[3] FCC, *In the Matter of Inquiry Concerning Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion*, Fourteenth Broadband Deployment Report, GN Docket No. 20-269, Jan. 19, 2021, https://docs.fcc.gov/public/attachments/FCC-21-18A1.pdf; *see also* FCC, "Broadband Progress Reports," https://www.fcc.gov/reports-research/reports/broadband-progress-reports (historical broadband deployment reports).

[4] Pew Research Center. Internet/Broadband Fact Sheet – Who Has Home Broadband, "Chart: % of Adults Who Say They Have a Broadband Connection at Home, by Annual Household Income," https://www.pewresearch.org/internet/fact-sheet/internet-broadband/?menuItem=480dace1-fd73-4f03-ad88-eae66e1f4217.

Figure 6: Share of Households That Report Having a Home Broadband Connection

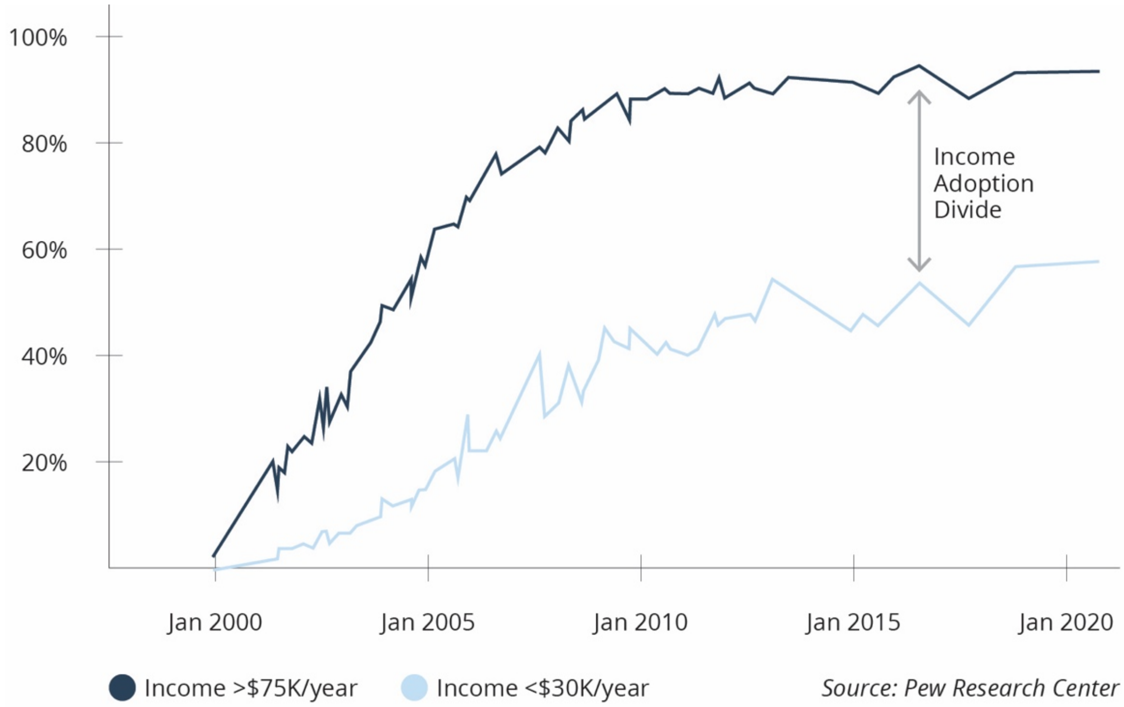

Figure 6 shows that the income adoption divide persists where less than 60% of low-income households report having an Internet subscription while more than 90% of high-income households do.[5] It is tempting to conclude that broadband must be too expensive for the remaining households who live in areas with broadband but do not subscribe to it. Certainly, for some that is true. But the reality is more complicated.

Ongoing surveys by the Pew Research Center show that affordability has steadily become less likely to be cited as a reason for not subscribing.[6]

[5] *Id.*

[6] Pew Research Center. June 2021. "Mobile Technology and Home Broadband 2021," https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2021/06/PI_2021.06.03_Mobile-Broadband_FINAL.pdf.

Figure 7: Share of Respondents Who Do Not Have Home Broadband Because....

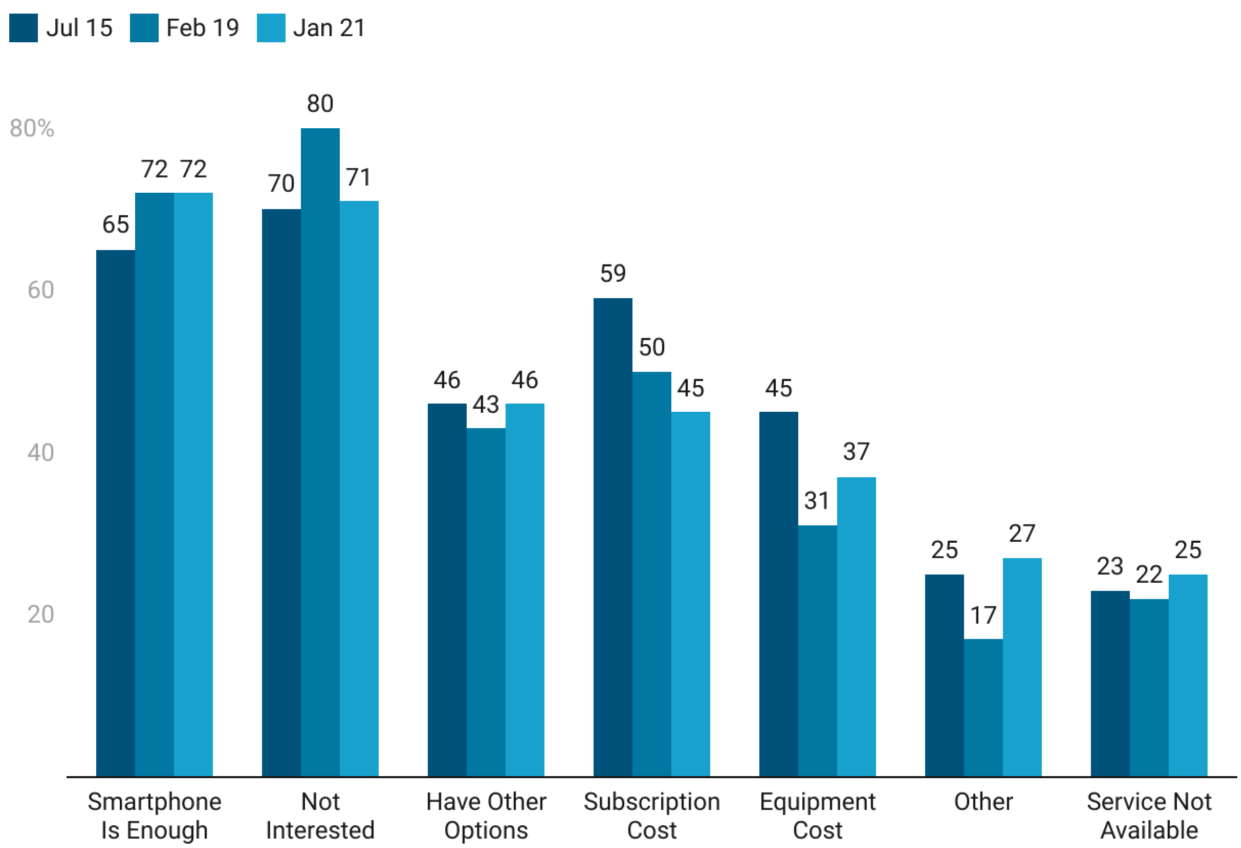

Chart: Technology Policy Institute • Source: Pew Research Center • Created with Datawrapper

Figure 7 shows that the top two reasons reported by survey participants for not having a home broadband connection are that a smartphone lets them do everything online they need to do and that the respondent is not interested.[7] Results showed that 71% of non-subscribers reported no interest nearly a year into the COVID-19 pandemic,[8] even though one might expect that broadband demand has increased with stay-at-home orders and a shift to remote schooling and work. Subscription cost and the availability of other options tie for third place as a reason for not having a home connection. The share of respondents who report cost as a barrier decreased by 14 percentage points, from 59% in 2015 to 45% in 2021.[9] Similarly, the share of respondents citing

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[7] *Id*. at 16 (BBSMART3: "Please tell me whether any of the following are reasons why you do not have high-speed internet at home. First, how about [INSERT ITEMS; RANDOMIZE]? Is this a reason why you do not have high-speed internet at home?"; "Item C: Based on non-broadband users who have a smartphone. c. Your smartphone lets you do everything online that you need to do.").

[8] *Id*. at 15 (BBSMART2: "Would you like to have high-speed internet at home, or is that not something you're interested in?"; "Based on non-broadband users [N=285].").

[9] *Id*. at 16 (BBSMART3: "Please tell me whether any of the following are reasons why you do not have high-speed internet at home. First, how about [INSERT ITEMS; RANDOMIZE]? Is this a reason why you do not have high-speed internet at home?"; "Item A: Based on non-broadband users a. The monthly cost of a home broadband subscription is too expensive.").

equipment cost decreased by 8 percentage points. The share of respondents who said their smartphone was enough for their broadband needs increased by 7 percentage points.

Even the share of respondents reporting cost as the most important reason for not subscribing has plummeted from 33% in 2015 to 20% in 2021, which is nearly tied with a smartphone being a sufficient substitute (Figure 8). The Pew survey unfortunately did not include “not interested” as a possible response to the question of the most important reason, so we do not know where it would have ranked in the most-important list.

Figure 8: Share of Respondents Noting That the Most Important Reason for Not Subscribing Is...

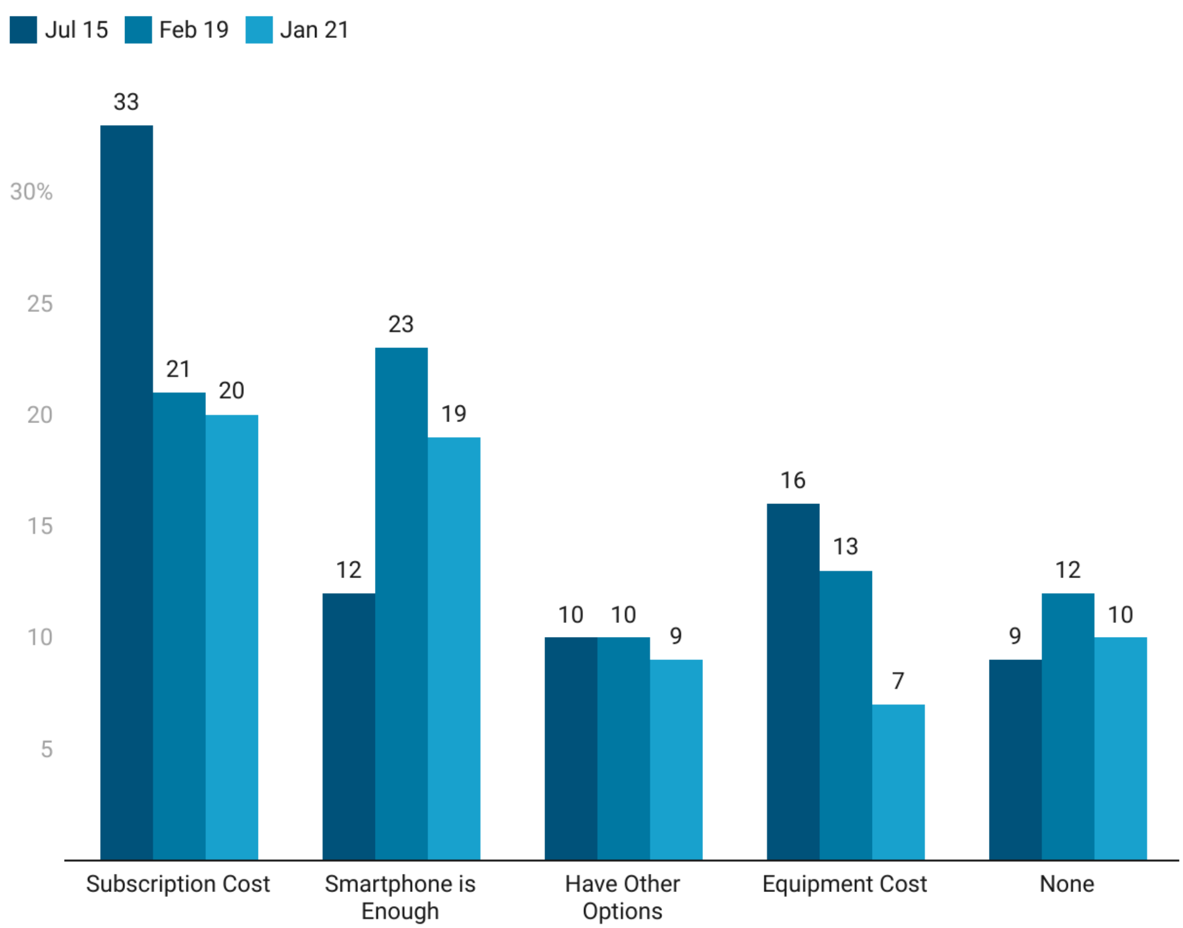


Chart: Technology Policy Institute • Source: Pew Research Center • Created with Datawrapper

The results suggest a changing landscape among the remaining non-adopters; fewer are concerned about cost, and more are seeing a smartphone as a substitute for a home connection. At first it seems odd that the share of respondents who said service was not available increased while broadband coverage expanded in the last six years. Likely that has to do with the changing nature of who remains offline; that is, many who previously reported that service was not available may now subscribe since that service has become available with ongoing broadband deployment.

These results are consistent with what we observe in the real world. Even at a price of zero, many households do not subscribe. If cost is not the key reason that the remaining unconnected low-income households do not subscribe, then what is?

We do not fully understand why the last unconnected group does not subscribe. As the surveys indicate, some truly have no interest. But we do not know the effects, for example, of digital literacy classes because their effectiveness has not been rigorously studied. If connecting this last group is a policy priority, then policymakers should consider funding experimental programs to rigorously evaluate what works and determine what gets the biggest bang for the buck.

4.3 Mapping and Data Collection

Identifying and addressing broadband policy issues depends on access to reliable data. That data is generally referred to as "mapping" or "broadband maps," although constant references to maps can be misleading since policy questions require different types of data.

Government data most frequently used are from (1) the FCC's Form 477 where broadband providers give information about what services they provide and where; (2) the U.S. Census, which provides through the American Community Survey and Current Population Survey the shares of the population connected to various types of broadband; and (3) the Universal Service Fund that subsidizes unserved and underserved areas and low-income households, and grants awards to specific schools, libraries, and school districts.

For some policy questions, this data is sufficient. It shows trends in build-out, both in geographic area covered and speeds and technology available, as well as trends in adoption by nearly any demographic or geographic area available in U.S. Census data.

For other policy matters, the data is not sufficient. The key disadvantage derives from the smallest geographic unit of observation being a census block. With more than 11 million census blocks across the country, this geographic unit is fairly disaggregated. However, the FCC counts any block as served by a provider if it serves at least one household in the block. That means Form 477 data overstates coverage and, more importantly, is insufficient for identifying unserved areas within the blocks.

The Broadband DATA Act included appropriations for more fine-grained maps of a "fabric" of data that includes building-level connectivity measurements.[10] Several programs such as the FCC's 5G Fund for Rural America and the Infrastructure Investment and Jobs Act broadband grants will rely on these new broadband maps to distribute universal service funds. The National Telecommunications and Information Administration (NTIA) has also received appropriations to

[10] Broadband Deployment Accuracy and Technological Availability (DATA) Act, Public Law 116-130 (Mar. 23, 2020).

build a state and federal broadband map in order to assist in the identification of unserved and underserved areas.

Many states, nonprofits, and commercial entities have broadband maps that display data layers that include the FCC's Form 477 data, the Census Bureau's subscription data, and speed test data, along with demographics and universal service subsidies. Some of the more sophisticated maps such as TPI's Broadband Map[11] include tools that allow the user to investigate the state of broadband across the country according to various minimum available speeds, whether 25/3, 100/100, or a custom download or upload speed combination. TPI's Broadband Map also includes historical data and dozens of geographic areas of interest from as small as a census block to larger areas such as congressional districts and states.[12]

Too frequently, observers talk as though new and better maps will finally end the uncertainty involved in identifying unserved areas. It should improve the process and reduce the uncertainty but will not likely eliminate it. Every dataset contains errors, and continuous investment in networks means that any map will be outdated quickly. Improving maps is important, but policymakers should not expect any given map or dataset to provide perfect information and should also focus on gathering insights by combining datasets.

4.4 Combining Datasets: The Broadband Connectivity Index (BCI)

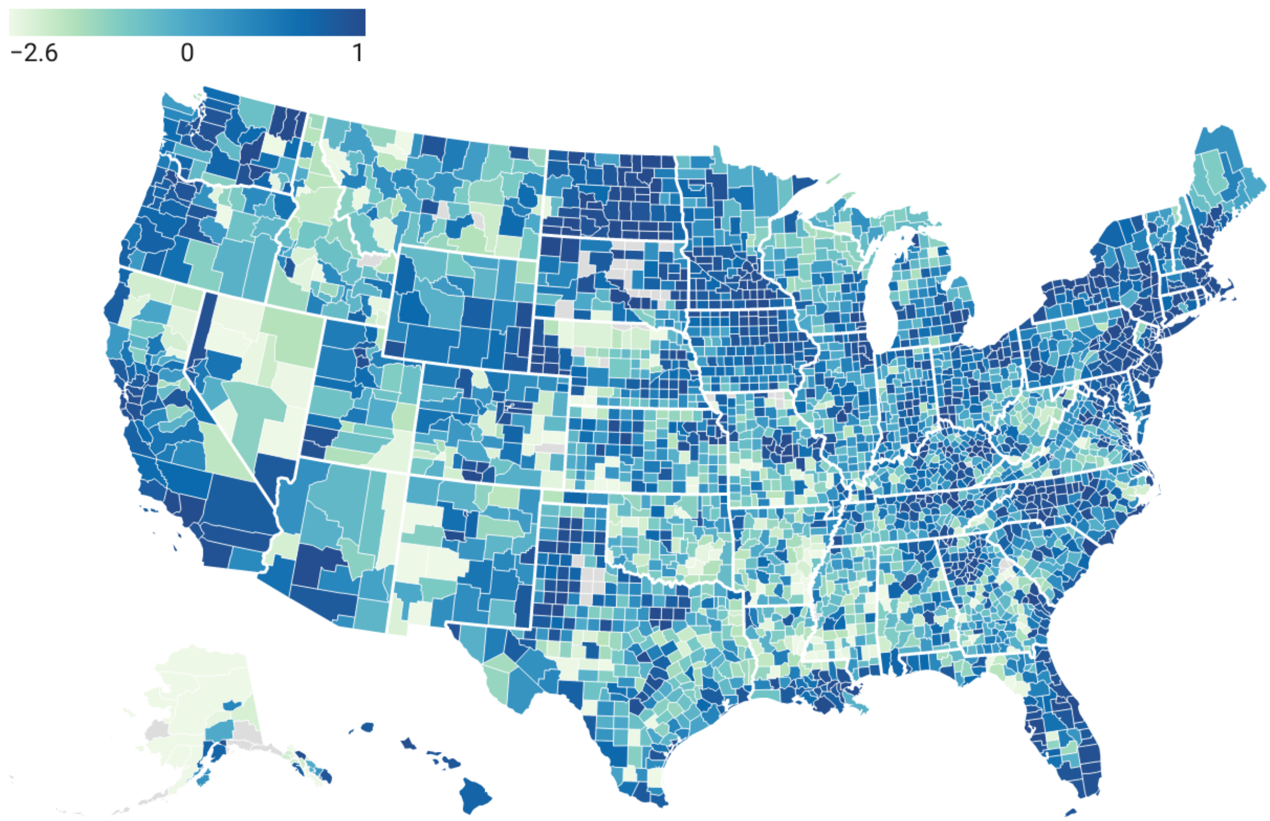
One way to incorporate the many dimensions of a broadband connection into a policy definition is by formulating an index that combines these inputs. TPI's Broadband Connectivity Index (BCI) is a methodology that balances the relevant factors into a quantifiable index.[13]

The index can be used to determine which areas are in more need than others and thus higher priority for subsidy dollars.[14] Rather than ranking places based only on available download and upload speeds, geographic areas can be evaluated based on other dimensions such as adoption, income, and other demographics.

The BCI uses a principal components analysis to create an index comprised of information from several sources. Specifically, it takes into account adoption, the share of households with access to 25/3 and 100/20 services, maximum available and measured speeds, and the number of broadband providers in the given geography.

[11] TPI Broadband Map, Technology Policy Institute, https://tpibroadband.com.
[12] *Id.*
[13] Scott Wallsten, "TPI's Broadband Connectivity Index," Sept. 16, 2021. Technology Policy Institute. https://techpolicyinstitute.org/publications/broadband/map/broadband-connectivity-index/.
[14] Scott Wallsten, "Using an Index to Target Broadband Subsidies: A Florida Example," Oct. 3, 2021. Technology Policy Institute. https://techpolicyinstitute.org/publications/broadband/map/florida_connectivity_index/.

Figure 9: TPI Broadband Connectivity Index at the County Level, 2020



Source: Technology Policy Institute, Broadband Connectivity Index (BCI) methodology.

Other indices have been formulated over the years to consider multiple dimensions of connectivity, with names such as the Digital Divide Index, the Broadband Adoption Index, the Broadband Efficiency Index, and the Global Connectivity Index. These other indices have different inputs in order to reflect different purposes of the index.

The TPI Broadband Connectivity Index is intended to help policymakers better identify areas most likely to benefit from some kind of intervention. Once identified, it is possible to look inside the index to see which factors are driving low scores.

Policymakers may sometimes see through this index that some data appear to be incorrect or missing. In those cases, they can direct some resources to collecting the relevant data. Targeting specific areas that lack data can help states conserve resources by targeting only specific areas rather than the entire state for data gathering.

5 Universal Service and Programs to Address the Digital Divide

Before the 1990s when telecommunication service was thought to be a natural monopoly and nearly every country had only one provider, the providers used internal cross-subsidies to deal with a connectivity divide, although nobody called it that. Profits from monopolies providing service in urban areas cross-subsidized unprofitable service in high-cost areas. Similarly, businesses paid higher rates to cross-subsidize lower rates for households.

Cross subsidies were no longer tenable as it was realized that telecommunications was not a natural monopoly and competition was allowed and encouraged. The 1996 Telecommunications Act started the Universal Service Fund (USF), which was meant to subsidize service to high-cost areas and people who could not afford service.

The USF consists of four main programs: High Cost (includes the Connect America Fund), Schools and Libraries (also known as E-Rate), Lifeline (low-income support), and Rural Health Care. Figure 10 shows spending on these programs from their inception.

Figure 10: Universal Service Expenditures in Billions of Nominal Dollars

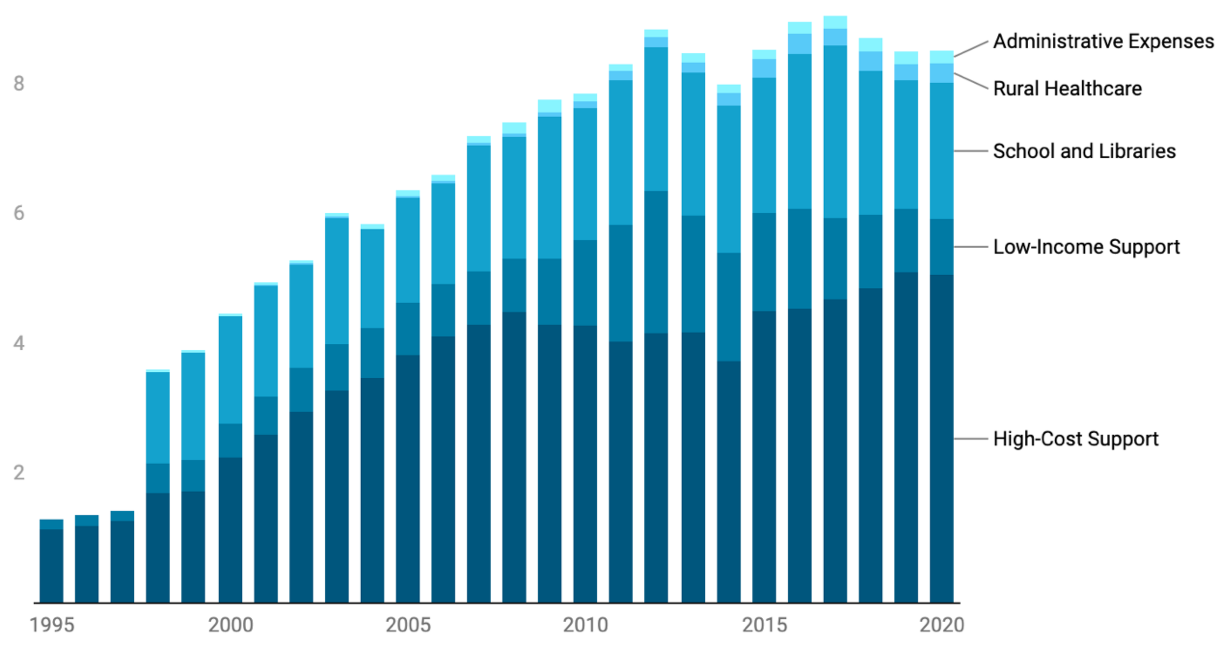


Chart: Technology Policy Institute • Source: USAC, FCC Monitoring Reports • Created with Datawrapper

Closing the adoption divide has proved to be a stubborn problem. The FCC and many states have allocated billions of dollars to address the issue, but the gap remains.

The broadband market is complex and dynamic. If we are to finally succeed in closing the digital divide, regulators and legislators must work to better understand the factors that affect supply, demand, and competition in the market, as well as learn from past triumphs and mistakes.

Without a greater emphasis on data collection, empirical analysis, and identifying and adopting best practices, any future subsidy programs are doomed to repeat past mistakes.

5.1 Legacy Programs Have Not Been Cost-Effective

Unfortunately, according to nearly every study conducted, these subsidy programs, particularly the high-cost programs, are not cost-effective. The Government Accountability Office (GAO) has published multiple reports on deficiencies, including "lack of performance goals and measures for the program and weak internal controls."[15] The Office of Management and Budget (OMB) has criticized the program for "inability to base funding decisions on measurable benefits."[16] GAO has previously raised alarms about the Lifeline program, noting delayed responses by the FCC to address problems it raised in earlier reports.[17] The Congressional Research Service (CRS) has noted concerns about the administration of the USF.[18]

In a 2013 report, CRS asked the USF a central question—"How is success defined?"[19] Aside from collecting and spending funds, are outcomes in broadband deployment and adoption properly measured and achieved? Regarding broadband deployment, how does the FCC set universal benchmarks for speed, capacity, and latency? Regarding broadband adoption and the digital divide, how does the FCC account for causal drivers of adoption such as cost, digital literacy, and lack of relevance?

A consequence of the lack of ongoing, rigorous evaluation of USF is that little empirical evidence exists on how best to address the digital divide.[20] More data is required to understand the gap, identify successful approaches, and craft policies that deliver the greatest return on expenditures.

The FCC should prioritize experimentation and rigorous data collection to facilitate the creation of better, more cost-effective policies based on empirical evidence and analysis.

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[15] GAO, *FCC Has Reformed the High-Cost Program, But Oversight and Management Could Be Improved*, (July 25, 2012), GAO-12-738, https://www.gao.gov/assets/600/592957.pdf.

[16] *Id.*

[17] GAO, *Additional Action Needed to Address Significant Risks in FCC's Lifeline Program*, GAO-17-538 (May 30, 2017), https://www.gao.gov/assets/690/684974.pdf; GAO, *Telecommunications: Improved Management Can Enhance FCC Decision Making for the Universal Service Fund Low-Income Program*, GAO-11-11 (Oct. 28, 2010), https://www.gao.gov/assets/320/312708.pdf; GAO, *Telecommunications: FCC Should Evaluate the Efficiency and Effectiveness of the Lifeline Program*, GAO-15-335 (Mar. 24, 2015), https://www.gao.gov/assets/670/669209.pdf.

[18] CRS Report, *Universal Service Fund: Background and Options for Reform*, RL33979, June 30, 2011, https://fas.org/sgp/crs/misc/RL33979.pdf; CRS Report, *Rural Broadband: The Roles of the Rural Utilities Service and the Universal Service Fund*, R42524, June 25, 2013, https://crsreports.congress.gov/product/pdf/R/R42524.

[19] *Id*. at 16.

[20] Sarah Oh and Scott Wallsten. 2021. Comments filed with the Federal Communications Commission. In the Matter of the Emergency Broadband Benefit Program, "Defining Objectives and Measuring Outcomes in the Emergency Broadband Benefit Program," Jan. 26, 2021. https://techpolicyinstitute.org/wp-content/uploads/2021/03/Oh-Wallsten-Comments-on-EBBP-1.pdf.

Some experiments have yielded important and suggestive results, including pointing out how little we know. For instance, in 2013, the FCC facilitated 14 experimental broadband projects as it studied modernizing the Lifeline program.[21] The projects—carried out by private wireline and wireless broadband providers—were designed to test low-income consumer preferences for Internet speed, the effects of various levels and types of discounts, and the effectiveness of methods of outreach.[22]

These experimental efforts produced surprising insights—customers are significantly less speed-conscious than previously thought; subscribers are willing to forego additional incentives to avoid taking digital literacy classes; and most of all, it is extremely difficult to get low-income people to subscribe to broadband if they don't do so already. Of all the participating companies in the projects, only two providers in Puerto Rico saw uptake rates exceeding 10% of expected participants. These curious but consistent results demonstrate the need for additional experimentation and analysis.

The FCC has since made progress to improve universal service programs, particularly by using competitive bidding via reverse auctions to distribute subsidies.[23] Reverse auctions to distribute subsidies have been shown to be more effective than other methods around the world such as cost-based support.[24] Still, the vast majority of funds for high-cost support are allocated without any bidding.

Lobbying efforts from entities that currently receive USF support make changing the USF program difficult. New programs will face similar challenges, but those have weaker constituencies. Officials can learn from the mistakes of existing USF programs so funding from new sources will have bigger impacts.

5.2 New Broadband Funds

In addition to the nearly $10 billion provided each year from the FCC's Universal Service Fund and the USDA's Rural Utilities Service, many additional federal programs are also subsidizing broadband.

The CARES Act of 2020 and the American Rescue Plan (ARP) of 2021 included significant funds for adoption and access programs. A few programs targeted broadband specifically, while other programs in ARP consisting of hundreds of billions of dollars allowed funds to be used for broadband but did not target it explicitly.
Table 2 lists these programs.

[21] Scott Wallsten, "Learning from the FCC's Lifeline Broadband Pilot Projects." Washington, D.C.: Technology Policy Institute.

[22] *Id.*

[23] Scott Wallsten, "Two Cheers for the FCC's Mobility Fund Reverse Auction," *Journal on Telecommunications and High Technology Law* 11, no. 2 (November 22, 2013).

[24] Scott Wallsten, "Reverse Auctions and Universal Telecommunications Service: Lessons from Global Experience," *Federal Communications Law Journal* 61, no. 2 (March 2009).

Table 2: COVID Relief and Infrastructure Funds for Broadband Access and Adoption

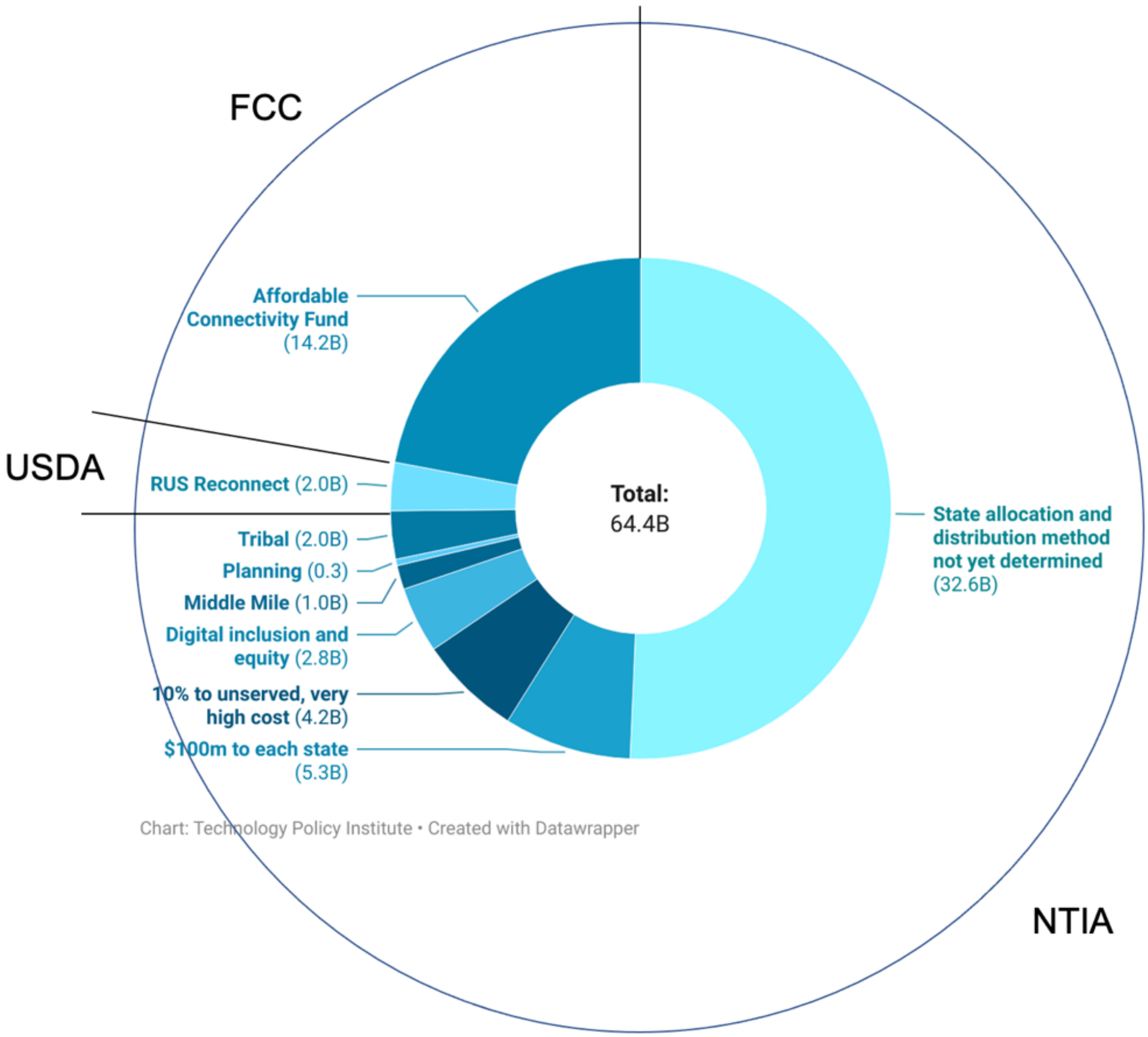
Program	Agency	Appropriations
CARES Act of 2020		
Coronavirus Relief Fund	Treasury	$150 billion
Education Stabilization Fund	DOE	$30.7 billion
COVID-19 Telehealth Program	FCC	$200 million
ReConnect Program	USDA RUS	$100 million
Institute of Museum and Library Services	IMLS	$50 million
Distance Learning and Telemedicine Grants	USDA RUS	$25 million
American Rescue Plan Act 2021		
State and Local Funding (water, sewer, broadband)	Treasury	$339 billion
Education Stabilization Fund	DOE	$165 billion
State and Localities Funding (for broadband)	Treasury	$11 billion
Coronavirus Capital Projects Fund	Treasury	$10 billion
Homeowner Assistance Fund	Treasury	$9.9 billion
Emergency Connectivity Fund	FCC	$7.17 billion
Rural Heatlh Care Pilot Program	USDA	$500 million
Institute of Museum and Library Services	IMLS	$200 million
Telehealth Support Program	HHS/IHS	$140 million
Consolidated Appropriations Act 2021		
Emergency Broadband Benefit	FCC	$3.2 billion
Secure and Trusted Comm. Net. Reimburs. Program	FCC	$1.9 billion
Tribal Broadband Connectivity Program	NTIA	$1 billion
Economic Development Assistance Programs	DOC	$305.5 million
Broadband Infrastructure Grant Program	NTIA	$300 million
Connecting Minority Communities	NTIA	$285 million
COVID-19 Connected Care Telehealth Program	FCC	$249.9 million
Education Stabilization Fund	DOE	$81.8 billion

The Infrastructure Investment and Jobs Act (IIJA) included nearly $65 billion for broadband access and digital equity, divided among a number of programs and agencies.[25]

Figure 11 illustrates how those funds are to be allocated.

[25] Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58 (Nov. 15, 2021).

Figure 11: IIJA Broadband Subsidies by Program and Administering Agency



The Affordable Connectivity Fund (ACP) (previously the Emergency Broadband Benefit), which provides $30 per month plus a one-time subsidy for equipment, should go a long way toward addressing affordability issues. The ACP supplements the pre-existing Lifeline program in the Universal Service Fund, which provides $9.25 per month.

A household can receive both ACP and Lifeline benefits simultaneously, which means eligible households can receive what is essentially a voucher for broadband of almost $40 per month.[26]

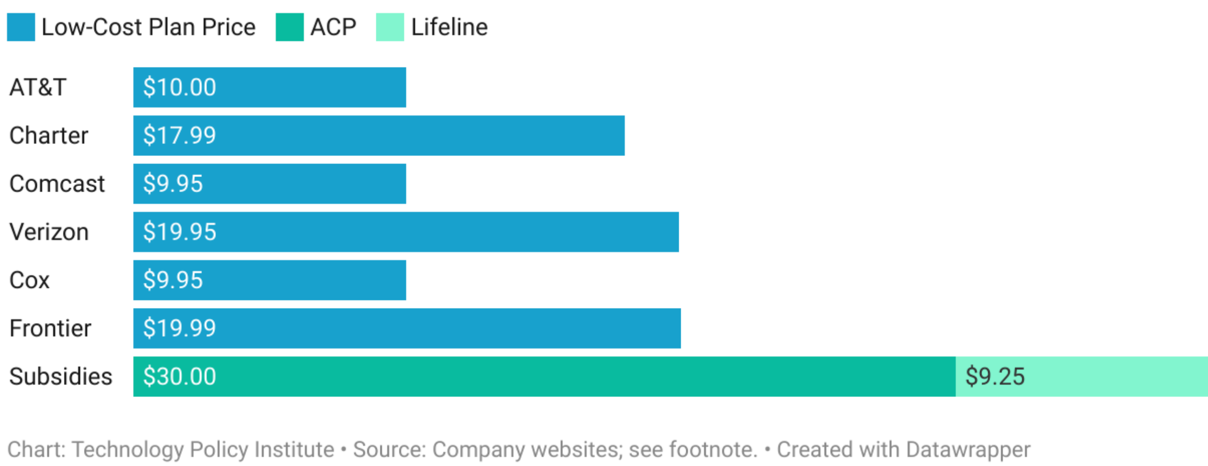
[26] Digital Beat, "Introducing the Affordable Connectivity Program," Jan. 21, 2022, Benton Foundation, https://www.benton.org/blog/introducing-affordable-connectivity-program ("Eligible households can participate in both the Lifeline program and Affordable Connectivity Program for the same or different services.").

5.3 Private Initiatives

Another instructive example of an adoption program comes from the private sector. Several ISPs offer low-cost broadband connections to eligible households. These private initiatives include Comcast's Internet Essentials (IE) ($9.95 per month for 15 Mbps), Spectrum's Internet Assist program ($14.99 per month for 30 Mbps), AT&T's Access program ($10 per month for 10 Mbps), and Cox's Connect2Compete program ($9.95 per month).[27]

The coexistence of programs offered by service providers targeted at low-income households from $10 to $20 per month means broadband has become essentially free for a large number of American households (Figure 12).

Figure 12: Monthly Price of Low-Income Broadband Plans Offered by ISPs and Available Subsidies[28]



Comcast's Internet Essentials program offers broadband services for $9.95 per month with no up-front modem fees, computer equipment for less than $150, and digital literacy training programs. Comcast reported more than 500,000 cumulative sign-ups to the IE program by mid-2015.[29] Ninety percent of new subscribers did not previously have broadband.[30] Empirical analysis by Rosston and Wallsten (2020) suggests that Internet adoption among the eligible

[27] *Id.*

[28] AT&T offers a $10/month plan, https://www.att.com/internet/access/; Charter's Internet Assist plan is $17.99/month, https://www.spectrum.com/policies/spectrum-broadband-disclosure; Comcast's Internet Essentials is $9.95/month, https://www.xfinity.com/support/articles/comcast-broadband-opportunity-program; Frontier's Fundamental Internet is $19.99/month, https://frontier.com/fundamental-internet; Verizon offers $20 off its plans for qualifying households, making one FiOS plan $19.95/month, https://www.verizon.com/info/low-income-internet/; Cox offers a $9.95/month plan, https://www.cox.com/residential/internet/connect2compete.html.

[29] Gregory Rosston and Scott Wallsten, "Increasing Low-Income Broadband Adoption Through Private Incentives," *Telecommunications Policy*, Oct. 2020, 44(9): https://www.sciencedirect.com/science/article/abs/pii/S0308596120301129

[30] *Id.*

population increased 10.2% between 2011 and 2015, and that 6.9 percentage points, or about 67%, of that increase was due to the IE program.[31]

Outcomes from Comcast's IE program yield at least two important lessons. First, targeting households without an Internet connection is important if the goal of a program is to increase adoption. That sounds obvious, but no federal subsidy program has done it, perhaps because policymakers see it as politically impossible. Second, as with the FCC experiments, lower prices encourage more low-income people to sign up, but that is not sufficient to encourage everyone.

6 How to Allocate Broadband Subsidies

The IIJA directs the states and the NTIA to formulate rules and processes to distribute subsidy funds from a variety of sources of state and federal appropriations. Government agencies have nearly 30 years of experience in distributing funds for broadband projects. This section describes proven components of cost-effective subsidy programs.

6.1 Competitive Bidding

Subsidy programs that distribute funds using market-based mechanisms are likely to be far more cost-effective than cost-based or grant-selection mechanisms. While the FCC has only begun to use competitive bidding on a relatively small scale, the basic idea is not new.

State governments use bidding methods in nearly every kind of procurement besides broadband. These processes have clear guidelines on how to select the entity that will provide whatever good or service the state is buying. The National Association of State Procurement Officials, for example, "supports implementing the American Bar Association (ABA) Model Procurement Code."[32] The ABA model code advocates competitive sealed bidding as the default method of public procurement.[33] The ABA report even describes criteria necessary for a fair and rigorous competitive sealed bidding process.[34]

Competitive procurements have been used around the world for decades to provide universal service in telecommunications.[35] In the United States, the FCC has used competitive procurements to award broadband subsidies under both Democratic and Republican

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[31] *Id.*

[32] 2020 Survey of State Procurement Practices, National Association of State Procurement Officials, https://www.naspo.org/wp-content/uploads/2021/02/Final_2020_State_Practices_Survey_Report-1.pdf.

[33] American Bar Association, 2007 Model Code for Public Infrastructure Procurement (MC PIP), Aug. 2007, https://www.americanbar.org/content/dam/aba/administrative/public_contract_law/pcl-model-01-2007-code-public-infrastructure-procurement.pdf.

[34] The sealed bid process is one possible objective method that is commonly used in procurement of construction projects. Other objective methods such as multiple round reverse auctions could be used.

[35] Scott Wallsten, "Reverse Auctions and Universal Telecommunications Service: Lessons from Global Experience," *Federal Communications Law Journal* 61, no. 2 (Mar. 2009).

administrations. Reverse auctions in particular have a proven track record of getting far more bang for the buck for rural build-out.[36]

Recent history has also shown that subjective evaluation through traditional grant applications and reviewer evaluations is not particularly effective. In 2009, the American Recovery and Reinvestment Act allocated $7 billion for broadband through the Broadband Technology Opportunities Program (BTOP).[37] A group of 71 economists, including Nobel Prize winners (one of us),[38] suggested competitive bidding as the best tool to allocate subsidies, just like a state gets bids for a project or a homeowner might get competitive bids to repair a roof.[39]

Competitive bidding for telecommunications services has been a major contributor to massive gains in consumer well-being. The FCC has run nearly 100 spectrum auctions and raised $200 billion for the U.S. Treasury. The 2020 Nobel Prize in Economics was awarded to Paul Milgrom and Robert Wilson in part for their work in helping design and refine the auctions. We should not dismiss this vast experience and proven success.[40]

Unfortunately, the NTIA ignored that advice and instead asked for grant submissions that were hand-reviewed by ad hoc assignments of volunteer experts.[41] The grant applications consisted of hundreds of pages of narrative; the scoring criteria were qualitative, and de minimis attention was given to price comparisons of potential suppliers. The result was an incoherent set of criteria applied inconsistently across proposals with no rigorous way to compare one proposal to another. One recent study found that the grant review method was barely better than random selection.[42]

6.2 How to Balance Policy Priorities

Policymakers may have a long list of policy priorities regarding broadband. When making grants, they need a coherent and consistent method of balancing those priorities, particularly when those priorities may conflict.

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[36] *Id.*

[37] GAO, "Recovery Act: Further Opportunities Exist to Strengthen Oversight of Broadband Stimulus Programs," GAO-10-823, Aug. 4, 2010, https://www.gao.gov/products/gao-10-823.

[38] "Comments of 71 Concerned Economists: Using Procurement Auctions to Allocate Broadband Stimulus Grants" (2009). *Congressional and Other Testimony*, 16, https://digitalcommons.wcl.american.edu/pub_disc_cong/16.

[39] *See* FCC Auctions Summary, Completed Spectrum Auctions, https://www.fcc.gov/auctions-summary; Royal Swedish Academy of Sciences, Press Release: The Prize in Economic Sciences 2020, Oct. 12, 2020, https://www.nobelprize.org/prizes/economic-sciences/2020/press-release/.

[40] *Id.*

[41] Gregory Rosston and Scott Wallsten, "The Broadband Stimulus, A Rural Boondoggle and Missed Opportunity," Nov. 2013, *I/S: A Journal of Law and Policy for the Information Society*, Vol. 9, No. 3 (2014), 453-470, https://kb.osu.edu/bitstream/handle/1811/73343/ISJLP_V9N3_453.pdf.

[42] Sarah Oh, "Using Reverse Auctions to Stretch Broadband Subsidy Dollars: Lessons from the Recovery Act of 2009," Jan. 2021, *Ohio State Technology Law Journal* (forthcoming 2022), https://techpolicyinstitute.org/wp-content/uploads/2021/03/Oh-Reverse-Auctions-Lessons-from-BTOP-Jan-2021.pdf.

NTIA, for example, asked how it can take into account "network reliability and availability, cybersecurity, resiliency, latency, or other service quality features and metrics . . . to ensure that projects will provide sustainable service, will best serve unserved and underserved communities, will provide accessible and affordable broadband in historically disconnected communities, and will benefit from ongoing investment from the network provider over time?"[43]

These criteria are probably best thought of as aspirational since choosing among competing projects inevitably means making trade-offs among criteria that are not entirely consistent with each other. For example, the most reliable and secure network possible would be more costly than a slightly less reliable network and therefore unable to cover as many households. A network that can be made available in a few months may be preferable to one that takes five years to build even if the longer timeline would result in a network with better service.

In the process of distributing universal service subsidies over the last 10 years, the FCC has developed a system to assign weights to various components of broadband. The weighting system explicitly acknowledges that several factors, not just download and upload speeds, affect a user's broadband experience. In the Rural Digital Opportunities Fund (RDOF) auction, the FCC used the following weighting scheme that evaluated provider bids based on quality of broadband connection and not just speed tiers. Table 3 shows those weights.[44]

Table 3: FCC RDOF Weights[45]

Performance Tier	Speed	Usage Allowance	Weight
Minimum	≥ 25/3 Mbps	≥ 250 GB or U.S. average, whichever is higher	50
Baseline	≥ 50/5 Mbps	≥ 250 GB or U.S. median, whichever is higher	35
Above Baseline	≥ 100/20 Mbps	≥ 2 TB	20
Gigabit	≥ 1 Gbps/500 Mbps	≥ 2 TB	0

Latency	Requirement	Weight
Low Latency	≤ 100 ms	0
High Latency	≤ 750 ms & MOS of ≥4	40

Source: https://www.fcc.gov/auction/904/factsheet. Note: The auction design applied these weights to the bidder's monetary bid to derive comparable scores. Lower scores are better.

A key question is how to derive the relevant weights or scores. States may be tempted to use qualitative scoring methods based on reviewers' subjective opinions about a proposal rather than objective metrics that reflect overall policy goals. They should avoid that temptation. Since everyone derives their opinions differently—in this example, reviewers are unlikely to have the

[43] 87 Fed. Reg. 1122, at 1124, Section III.13.
[44] FCC Auction 904: Rural Digital Opportunity Fund, Fact Sheet, https://www.fcc.gov/auction/904/factsheet.
[45] FCC Fact Sheet, Rural Digital Opportunity Fund, Jan. 9, 2020, https://docs.fcc.gov/public/attachments/DOC-361785A1.pdf, ¶ 39.

same definition of what constitutes a superior grant proposal—and thinks about relative numbers differently, such scores will be almost meaningless. Instead, predetermined weights should be used and overall scores should be based on standard, measurable criteria.

Those weights should reflect how much consumers value one priority relative to another, including time to provide service because broadband service available tomorrow is worth more than broadband service provided five years from now. Weights can also allow states to implement policy priorities of, say, subsidizing service in unserved areas rather than overbuild projects in underserved areas.

In short, states will need a coherent method to make trade-offs based on consumer preferences. Assigning specific weights to each performance factor in advance of the evaluations can allow the grant-maker to make objective decisions about which project to fund. Avoiding this exercise—that is, not explicitly assigning weights to quantifiable factors—would make the selection process inherently and irreparably arbitrary.

6.3 The Siren Song of Future-Proofing

Calls for broadband subsidies often call for future-proofing the network. Although this objective is rarely defined specifically, it is supposed to ensure that a network is somehow ready for future applications. Considering only the potential benefits is, of course, an incomplete way to think about investment. When considering where and how to spend scarce resources, the answer should always be some form of maximizing the net present value of benefits, which means also considering the cost. If network A is expected to manage traffic for the next 20 years and is 10 times as expensive as network B, but network B will need upgrades every five years, then network B will probably be the better network if the expected net present value of investment in network B is less than the up-front cost of network A.

Some argue that future-proofing is important because we face a chicken-and-egg problem—bandwidth has to be widely available and adopted for new services that require the bandwidth, but we won't see those new services unless the bandwidth for them to work exists. In principle, this argument is correct. But available bandwidth has been growing steadily while the bandwidth requirements of popular and important applications have not. As far as we know, no economics studies provide evidence that a 100/100 standard, much less a gigabit, would promote additional innovation.

In short, calls for future-proofing are not based on any evidence that it is likely to bring net benefits for consumers or taxpayers.

6.4 Accountability, Transparency, and Evaluation

One advantage of states implementing their own plans is that comparisons of various approaches become possible. That is, as long as NTIA collects the right data, we will be able to see which approaches are working and which ones are not. Evaluation requires transparency, not just of grant recipients but also of grantors. NTIA should require states to release to the public the application materials of all proposals, not just funded proposals. By publishing the data of only winning bids, the states would be missing valuable information on the bids that did not get awarded. No evaluation of selection mechanisms will be fully valid if data is available only for funded projects.

Data collection and public release of build-out proposals should be mandated from the beginning. In studies of the 2009 BTOP program, we found that if NTIA had collected better metrics from the proposed grants, we would have gleaned a much better understanding of the broadband supply.[46] NTIA could have better organized its data and released it rather than a data dump of documents with large amounts of redacted and missing data.[47] NTIA should require states to publish spreadsheets with standard metrics on prices, quantities, and dimensions of broadband networks as proposed by suppliers and set forth in the scoring metrics.

NTIA should also reaffirm the responsibility of ISPs to submit deployment data to the FCC after build-out. Municipally run networks in particular tend to flout those requirements, making evaluation difficult. One study found that only 71 of 528 municipal broadband networks reported required data to the FCC on Form 477.[48] As far as we know, these networks are not in compliance with the data collection rules set by the FCC, leading to an incomplete picture of broadband connectivity that further exacerbates efforts to subsidize more infrastructure where it is needed the most.

7 Policy Ideas Whose Popularity Exceeds Their Effectiveness

Some ideas are frequently floated as tools for closing the digital divide or improving broadband service, including treating broadband like a public utility, having local governments build and operate networks, and classifying ISPs as Title II carriers. The evidence does not support the idea that they would be helpful.

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[46] Gregory Rosston and Scott Wallsten, "The Broadband Stimulus, A Rural Boondoggle and Missed Opportunity," Nov. 2013, *I/S: A Journal of Law and Policy for the Information Society*, Vol. 9, No. 3 (2014), 453-470, at 455, https://kb.osu.edu/bitstream/handle/1811/73343/ISJLP_V9N3_453.pdf.

[47] Redactions should be rare in order to provide transparency in broadband deployment and build-out proposals.

[48] Sarah Oh, "What Are the Economic Effects of Municipal Broadband?," *TPRC47: The 47th Research Conference on Communication, Information and Internet Policy*, July 26, 2019, https://ssrn.com/abstract=3426247 or http://dx.doi.org/10.2139/ssrn.3426247.

7.1 Broadband as a Public Utility

Some argue that treating broadband as a public utility is a key to expanding access.[49] The argument usually begins with a rhetorical question such as, "Electricity is a utility; what makes broadband any different?" Both electricity and broadband can be considered general purpose technologies with huge impacts across the economy, and both have private and public providers, even though both are primarily privately owned. Finally, advocates point to the history of rural electrification as a model for broadband build-out.

These comparisons, however, actually suggest that treating broadband as we do electricity is likely to yield outcomes most would want to avoid in terms of prices, innovation, productivity, and build-out speed. One explanation for the differences may be that broadband has facilities-based competition, whereas electricity distribution almost always relies on a single provider. Still, the comparisons are instructive.

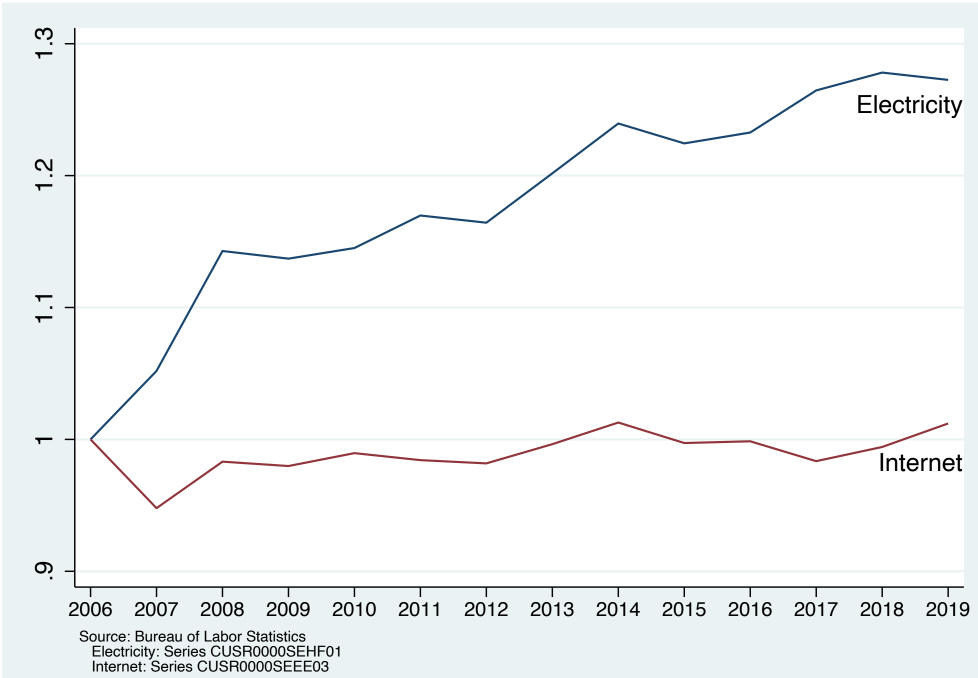
Prices are notoriously difficult to measure. They can vary across many dimensions, making comparisons even within an industry difficult; and the quality of the product can change over time, making comparisons over time difficult. The Bureau of Labor Statistics (BLS) puts enormous effort into creating price indices that address these problems, enabling comparisons across industries over time. The most recognized index is the Consumer Price Index,[50] which measures prices of a basket of goods and is the main overall inflation measure.

The BLS also calculates price indices for a wide range of industries, including electricity[51] and Internet access.[52]

Figure 13 shows these two price indices, both indexed to 1 at 2006. The figure shows that while electricity prices have increased about 25% since 2006, Internet access prices have not increased much at all.

[49] Material in this section has been published in Scott Wallsten, "Is Broadband a Public Utility? Let's Hope Not," May 21, 2020, *Technology Policy Institute*, https://techpolicyinstitute.org/publications/broadband/is-broadband-a-public-utility-lets-hope-not/.
[50] U.S. Bureau of Labor Statistics, Consumer Price Index, https://www.bls.gov/cpi/.
[51] Federal Reserve Bank of St. Louis, FRED Economic Data, Consumer Price Index for All Urban Consumers: Electricity in U.S. City Average, https://fred.stlouisfed.org/graph/?g=eH1r.
[52] U.S. Bureau of Labor Statistics, https://download.bls.gov/pub/time.series/cu/cu.data.17.USEducationAndCommunication.

Figure 13: Electricity and Internet Price Indices (2006=1)



Note: Both indices are available back to 1997, but including data prior to 2006 exaggerates the difference, making Internet prices appear to decrease even faster. This exaggeration occurs because American Online (now AOL) reduced the price of its service to $0 between 2005 and 2006. At the time, it had an outsized influence on the index, making it appear as if the entire industry saw a large price decrease from 2005 to 2006.

The point here is not to say what prices should be or that the price of electricity has increased too much. After all, one might argue that electricity produced with certain fossil fuels such as coal should cost even more to account for pollution externalities. Instead, the point is that the history of prices in these two sectors does not suggest that consumers would be better off in terms of cost if living under an electric utility model. To the contrary, BLS data show that electricity prices increased faster than broadband prices.

BLS similarly tracks productivity growth by industry, including electric power generation, transmission, and distribution (NAICS 2211);[53] wired telecommunications carriers (NAICS 517311);[54] and wireless telecommunications carriers (NAICS 5172).[55]

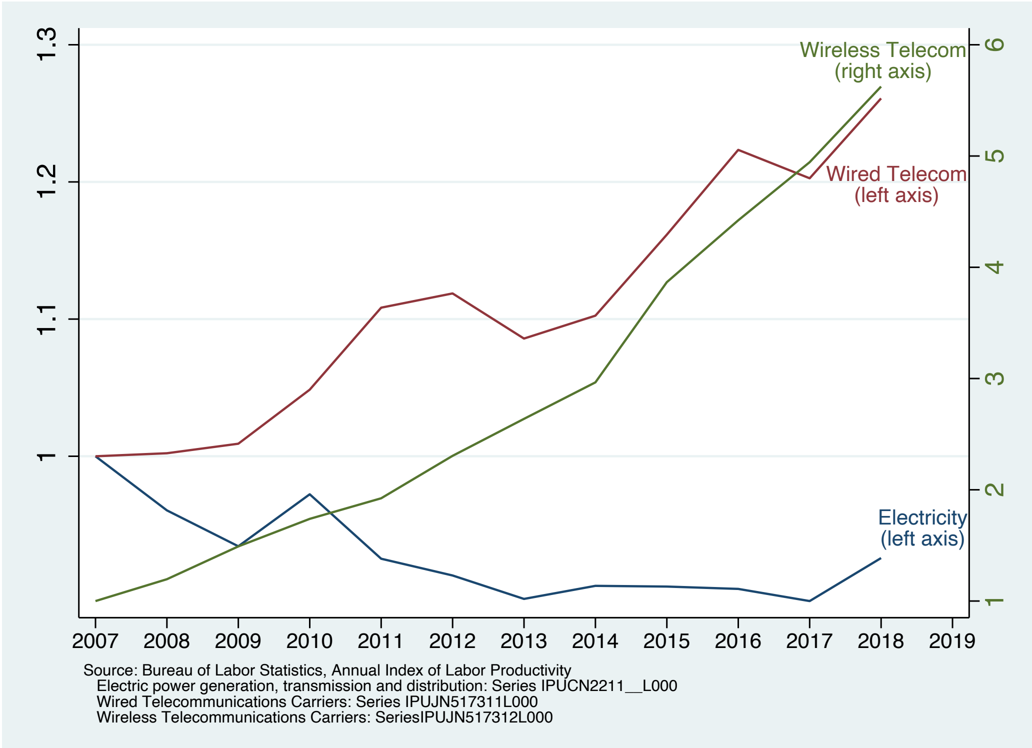
Figure 14 shows changes in labor productivity for these three sectors, all indexed to 1 in 2007.

[53] NAICS Association, NAICS Code Description: 2211 - Electric Power Generation, Transmission and Distribution, https://www.naics.com/naics-code-description/?code=2211.

[54] NAICS Association, NAICS Code Description: 517311 - Wired Telecommunications Carriers, https://www.naics.com/naics-code-description/?code=517311.

[55] NAICS Association, NAICS Code Description: 517312 - Wireless Telecommunications Carriers (except Satellite), https://www.naics.com/naics-code-description/?code=517312.

Figure 14: Labor Productivity Changes in Electricity and Telecommunications Carriers (2007=1)



The figure shows no productivity growth among electric utilities from 2007–2019, consistent with the McKinsey report. To the contrary, productivity in the electricity sector decreased over that time period. By contrast, wired carrier productivity increased about 25%, and wireless carrier productivity increased more than 5 times.

One explanation for why pricing has increased for broadband much less than electric utilities and why productivity has increased so much more for telecommunications providers is related to innovation. In 2016, the National Science Foundation (NSF) began asking companies specifically about new products and processes they introduced.[56]

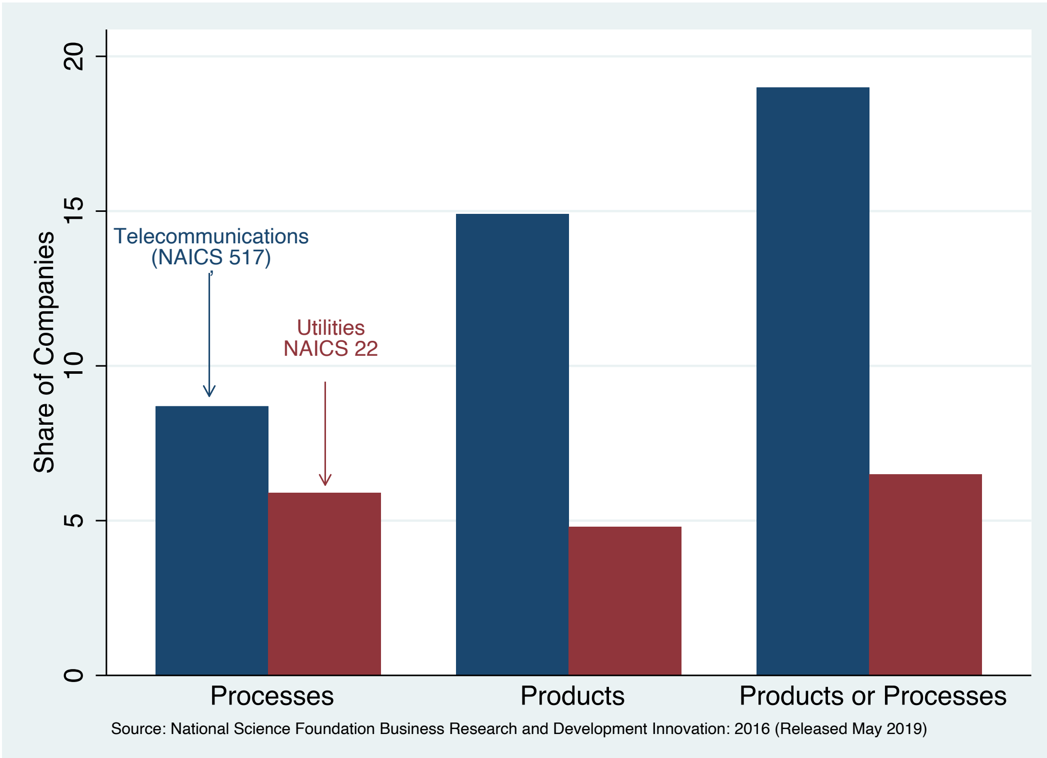
Figure 15 shows the share of companies classified as utilities (NAICS 22)[57] and telecommunications companies (NAICS 517)[58] that introduced significantly improved products or processes in 2016.

[56] National Science Foundation, Summary of Survey Content, Business R&D and Innovation Survey (BRDIS), https://nsf.gov/statistics/srvyindustry/about/brdis/summary.cfm.

[57] NAICS Association, NAICS Code Description: 22 – Utilities, https://www.naics.com/naics-code-description/?code=22.

[58] NAICS Association, NAICS Code Description: 517 – Telecommunications, https://www.naics.com/naics-code-description/?code=517.

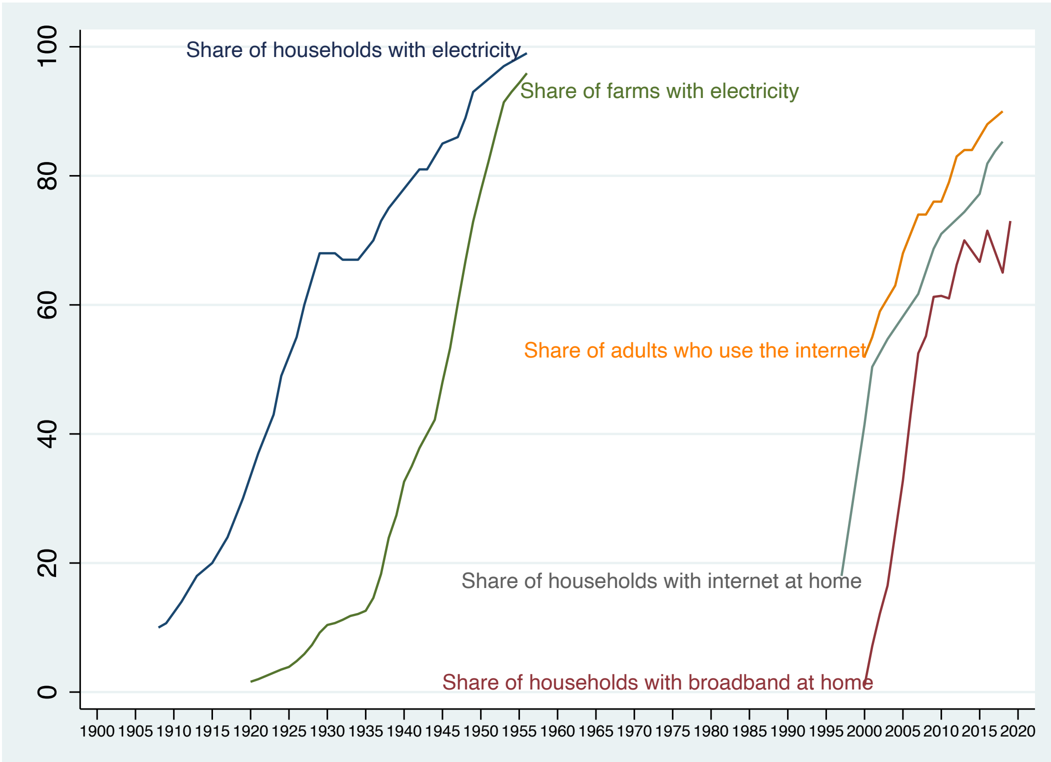
Figure 15: Share of Utility and Telecommunications Companies Introducing Significantly Improved Products and Processes, 2016



The figure shows that far more companies classified as telecommunications introduced new products or services than utilities did.

Rapid electrification of the United States, including rural areas, in the first half of the 20th century is rightly regarded as a major success. But the country did not adopt electricity faster than it has adopted Internet and broadband, as Figure 16 shows. It took about 25 years to go from 10% to 70% electricity adoption and 15 years to make that same jump for broadband.

Figure 16: Electricity and Internet Adoption



Note: These lines show adoption of the technology. Availability must be higher than adoption for both.

Electricity made it to 100% of households by around 1957. We will have to wait another 30 years or so to see if broadband can fully match the pace of electricity adoption.

In short, the evidence does not support the argument that considering broadband to be a public utility would be helpful in any meaningful way.

It is possible that some do not mean to imply that broadband should be modeled literally on public utilities such as electricity and water but instead be treated as a common carrier. The next subsection discusses that issue.

7.2 Title II Classification

Title II refers to a section of the Communications Act of 1934 that declared providers of communications by wire or radio to be common carriers, which allowed the FCC to regulate many aspects of the industry, including interconnection and prices.[59] The Telecommunications Act of 1996, however, classified ISPs as information services under Title I of the Act, keeping

[59] Communications Act of 1934, Pub. L. No. 73–416.

them much more lightly regulated.[60] The debate over whether ISPs should be regulated under Title I or Title II has since continued.

Common carrier laws have historically led to some problematic and costly outcomes. Even when established with the best of intentions, regulations do not necessarily work for the public good.[61] Instead, they become the product of lobbying by interested parties ranging from companies to public interest groups to Congress and others over how to distribute profits. The interactions between the regulator and those parties inevitably led to increasingly complex and politicized regulatory regimes. There's no reason to believe it will be any different this time.

The Interstate Commerce Commission (ICC), established in 1887 to regulate railroads in response to farmers' claims of rate discrimination, was decommissioned at the end of 1995.[62] The ICC's enabling legislation made it illegal for any common carrier to "make or give any undue or unreasonable preference or advantage to any particular person, company, firm, corporation, or locality, or any particular description of traffic, in any respect whatsoever."[63] In other words, there could be no preferential treatment.

That nondiscrimination sounds simple, but it wasn't. In 1908, railroads filed nearly 229,000 rates with the ICC. These tariffs differed by distance and what was being transported. The ICC even had a full-time classification committee dedicated to setting allowable maximum prices for various types of freight.

Initially, railroad profits increased. When trucking began to compete with railroads, the ICC also regulated the trucking industry, which became a legal cartel with no incentive to innovate and later fought deregulation. Meanwhile, regulations prevented railroad companies from adapting, driving several into bankruptcy.

Natural gas regulation has a similar history. Even though one cubic meter of gas is pretty much like any other cubic meter of gas, in 1976 the energy regulator established five types of gas based on vintage in order to promote exploration.[64] By the time this regulatory regime was dismantled in 1978, the number of categories had ballooned to 28.

The historical costs of regulating telecommunications as a public utility are well understood.[65] Regulations protected Ma Bell's monopoly by blocking entry, not just from competing

[60] Telecommunications Act of 1996, Pub. L. No. 104-104.

[61] Material in this section has been published in Scott Wallsten, "FCC Effort to Regulate Internet Ignores History of Past Failures," *The Conversation*, Feb. 24, 2015, http://theconversation.com/fcc-effort-to-regulate-internet-ignores-history-of-past-failures-37953.

[62] U.S. Senate, "The Interstate Commerce Act is Passed," Feb. 4, 1887, https://www.senate.gov/artandhistory/history/minute/Interstate_Commerce_Act_Is_Passed.htm.

[63] Interstate Commerce Act of 1887, Pub. L. No. 49-104.

[64] W. Kip Viscusi, Joseph E. Harrington Jr., and John M. Vernon. 2005. *Economics of Regulation and Antitrust* (Boston: MIT Press, 4th ed.), at 675.

[65] Paul Joskow and Roger G. Noll, "Regulation in Theory and Practice: An Overview," in Studies in Public Regulation (The MIT Press): 1–78, http://www.nber.org/chapters/c11429.pdf; Joskow, Paul and Roger G. Noll, "Alfred E. Kahn, 1917–2010," Review of Industrial Organization, 42, 107–126 (2013), http://link.springer.com/article/10.1007%2Fs11151-012-9370-8; Hausman, Jerry, "Valuing the Effect of Regulation

companies but also from the company's own innovations such as mobile telephony, which the FCC denied AT&T permission to deploy for a decade.

7.3 Net Neutrality

Net neutrality (NN) is often discussed under the rubric of the Title I/Title II debate, but at its core, NN is a modern incarnation of the ongoing question of how to provide access to networks with high fixed costs and low marginal costs. This has always been a fraught issue, generally involving trade-offs between short-term gains in more intensive network use and long-term costs of lower or less efficient investments. NN doesn't have one definition but instead encompasses a swath of concerns surrounding the potential for ISPs to promote their own services, harm competitors, and otherwise stifle innovation.

The FCC has gone through several iterations of official positions on net neutrality, as Table 4 highlights.

Table 4: FCC Rules Related to Net Neutrality

Year	FCC Chairman	Net Neutrality Rules
1997	Reed Hundt	Light-touch (not an issue)
2004	Michael Powell	4 "Net Freedom" principles
2015	Tom Wheeler	Open Internet Order (OIO)
2018	Ajit Pai	Restoring Internet Freedom (RIF)

Consistent with the history of common carrier regulations in other industries, industry participants immediately petitioned the FCC to stop ISP practices they did not like after the FCC adopted net neutrality rules in 2015. Those included investigations into deals such as those between Netflix and ISPs, lobbying against a plan by MetroPCS to stream YouTube,[66] and complaints about T-Mobile's plan to offer unlimited music streaming,[67] to name just a few. And those issues are simple compared to ones the FCC would likely face under a strict NN rule for services that would violate NN principles but would likely be popular such as guaranteed higher-quality telehealth or telelearning connections.

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on New Services in Telecommunications," Brookings Papers on Economic Activity, 1997, 28(1997): 1–54, https://www.brookings.edu/wp-content/uploads/1997/01/1997_bpeamicro_hausman.pdf.

[66] Ryan Singel, "Accused of Violating Net Neutrality, MetroPCS Sues FCC," Jan. 25, 2011, http://www.wired.com/2011/01/metropcs-net-neutrality-challenge/.

[67] Jared Newman, "T-Mobile's Unlimited Music Streaming Is the Worst for Net Neutrality," Jun. 19, 2014, http://time.com/2901142/t-mobile-unlimited-music-net-neutrality/.

7.4 Municipal Broadband

The idea of municipal broadband networks—networks built and operated by a city or other local government—has become popular for many. The U.S. Treasury issued this guidance on spending from the American Rescue Plan Act of 2021 for broadband: "Treasury also encourages Recipients to prioritize Projects that involve broadband networks owned, operated by or affiliated with local governments, non-profits, and co-operatives—providers with less pressure to generate profits and with a commitment to serving entire communities."[68]

The evidence on municipal networks does not support this kind of endorsement.[69] One problem is that municipal networks operate much less transparently than other broadband networks. For example, all ISPs, including municipal networks, are required to fill out the FCC's Form 477, which provides important data to understand the state of broadband, as discussed above. But Sarah Oh (2019) found that of 528 municipal providers listed in the Institute for Local Self Reliance, only 71 actually reported Form 477 data to the FCC.[70]

Building a broadband network is an expensive, labor-intensive process that can create significant financial burdens. The town of Monticello, Minnesota, provides an instructive example. In 2007, the residents of Monticello were unhappy with the service provided by TDS Telecom and voted to create their own network called FiberNet.[71] The town issued $26.5 million in high-interest revenue bonds for the project on the optimistic assumption that 60% of residents would subscribe to the network within a few years.[72] Unfortunately, litigation, construction delays, and aggressive competition from other ISPs led to revenue shortfalls that threatened to derail the project. The town loaned FiberNet $5 million from other city sources to cover the revenue shortfalls, but the reservoir soon ran dry.[73] FiberNet defaulted on its debts, and Monticello eventually settled with bondholders to the tune of $5.75 million in general obligation bonds.[74]

Municipal broadband networks aren't necessarily doomed to failure, but even the success stories don't produce the benefits touted by advocates. For instance, a 2019 analysis of data submitted to the FCC by municipalities with publicly funded broadband networks found no significant relationship among unemployment, labor force participation, or broadband adoption rates in towns with publicly funded networks, suggesting that the hypothetical benefits of municipal broadband are overblown at best.[75] If these supposed benefits never materialize, municipalities will have to make tough choices about how to pay for their networks, which means either

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[68] U.S. Department of Treasury, "Guidance for the Coronavirus Capital Projects Fund: For States, Territories & Freely Associated States," Sept. 2021, p. 3, https://home.treasury.gov/system/files/136/Capital-Projects-Fund-Guidance-States-Territories-and-Freely-Associated-States.pdf.

[69] Sarah Oh, "What Are the Economic Effects of Municipal Broadband?," *TPRC47: The 47th Research Conference on Communication, Information and Internet Policy*, July 26, 2019, https://ssrn.com/abstract=3426247 or http://dx.doi.org/10.2139/ssrn.3426247.

[70] *Id.*

[71] Mike Schlasner, "FiberNet Monticello – What the Telecom Industry Won't Tell You," Sept. 1, 2016, *Rochester Internet for All*, http://rochinternet4all.org/2016/09/01/fibernet-monticello-telecom-industry-wont-tell/.

[72] *Id.*

[73] *Id.*

[74] *Id.*

[75] Oh, *supra* note 69.

increased taxes, looting other sources for funding, or reallocating funds from more important budget items. It is hard to justify reallocating funds from education, law enforcement, fire service, road maintenance, and other services to pay for building and maintaining broadband networks, especially since most government services lack a private sector equivalent to broadband service.

8 Conclusion

Massive amounts of subsidies for broadband are being distributed across the country. State and local officials who have not had to manage broadband grants on this scale or even at all find themselves needing to learn a lot of new information quickly. This Guidebook provides an overview of many broadband public policy issues, focused particularly on how to best distribute subsidies. We will update it periodically in hopes it will prove useful.

Broadband policy has the potential to be leveraged for great gains for economic growth and development. Yet too often we have observed waste and misallocated capital outlays. It's the nature of government programs to have error rates and overhead costs, but now with decades of experience with broadband subsidy programs, we can expect more and learn from the past.

Improvements on data collection and program evaluation are cost-effective ways to improve future rounds of broadband policymaking. We should expect our regulatory agencies and state governments to track and measure outcomes. As we observe where and how broadband funds are spent in 2022 and over the next few years, this *Broadband Policy Guidebook* will be updated with new material. Getting more bang for the buck is not too much to expect from these new public outlays.

Appendix 1: State Broadband Plans and State Broadband Maps

Each state will receive broadband funds to distribute to projects in their jurisdictions. Before they distribute the funds, NTIA will review broadband plans from each state.[76] State governments will formulate plans and priorities and do so by establishing broadband offices. Most states have broadband offices tasked by their governors and state legislatures to develop broadband maps, datasets, and priorities, and to administer grant and procurements for broadband infrastructure, broadband adoption, and digital literacy programs.

NTIA has convened a State Broadband Leaders Network (SBLN) through its BroadbandUSA program.[77] This network of state broadband offices is part of the NTIA's efforts to work with the states to implement the IIJA. Each state has state-level priorities and plans but also relies on federal coordination to receive grant funds.

In the IIJA's Broadband Equity, Access, and Deployment (BEAD) Program, Congress appropriated $42.45 billion to the states, territories, District of Columbia, and Puerto Rico for broadband deployment, mapping, equity, and adoption programs.[78] Each state and territory will receive at least $100 million with an additional $100 million divided equally among the U.S. Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands.[79]

In the second of three phases, states will be required to submit a broadband plan to the NTIA.[80] The NTIA will review these plans and determine if states can access additional planning funds from the NTIA beyond the initial allocation of $5 million.

State broadband plans will need to show a roadmap for how states and territories will use IIJA funds to "bring reliable, affordable, high-speed broadband to all residents" in their respective jurisdictions.[81] Doing so will require an analysis of unserved areas and a determination of policy priorities specific to each state and in-state locality.

How these state broadband plans will differ from one another will depend on the topography and population of each state, how established its current state broadband programs are, and how governors and state legislators make decisions on policy trade-offs in their districts. One commonality among the state broadband plans is the need for accurate data and analysis tools.

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[76] *Notice, Request for Comment re: Infrastructure Investment and Jobs Act Implementation*, 87 Fed. Reg. 1122, Docket No. 220105-0002, RIN 0660-ZA33, Jan. 10, 2021, https://www.ntia.doc.gov/files/ntia/publications/fr-iija-broadband-rfc.pdf.

[77] NTIA, State Broadband Leaders Network (SBLN), https://broadbandusa.ntia.doc.gov/resources/state-broadband-leaders-network-sbln.

[78] *Id*. at 1124.

[79] *Id*.

[80] *Id*.

[81] https://www.federalregister.gov/documents/2022/01/10/2022-00221/infrastructure-investment-and-jobs-act-implementation

Most states and territories have some form of broadband map on their state government web pages. For the most part, these broadband maps show FCC Form 477 data, American Community Survey data, and a variety of speed and usage data. Many states have state-specific datasets generated by their own offices. Table 5 shows a list of state broadband maps. An overview of state broadband maps is included in Appendix 4: Compendium of State Broadband Maps.

Table 5: State Broadband Maps
(as of March 24, 2022)

State	Office	URL
Alabama	Alabama Department of Economic and Community Affairs	https://adecagis.alabama.gov/broadband2021/
Alaska	Connect Alaska	https://cngis.maps.arcgis.com/apps/webappviewer/index.html
Arizona	Making Action Possible for Southern Arizona	https://mapazdashboard.arizona.edu/infrastructure/internet-access/internet-access
Arkansas	Arkansas State Broadband Office: Arkansas Rural Connect	https://adfa-gov.maps.arcgis.com/apps/instant/interactivelegend/index.html?appid=c6ad9ab8cd044ec3ba373f2bdbbb7ee7
California	California Public Utilities Commission	https://www.broadbandmap.ca.gov/
Colorado	Colorado Broadband Office	https://gis.colorado.gov/broadbandviewer/index.html?Viewer=broadbandmapping.broadbandmapping_hv/
Connecticut	None	None
Delaware	None	None
Florida	Florida Office of Broadband	None
Georgia	Georgia Department of Community Affairs	https://broadband.georgia.gov/2021-georgia-broadband-availability-map
Hawaii	Hawaii Department of Commerce and Consumer Affairs - Broadband	http://cca.hawaii.gov/broadband/no-internet-service-map/
Idaho	None	None
Illinois	Connect Illinois	https://www.arcgis.com/apps/webappviewer/index.html?id=5cc319448a284a6e9933c02bb9e01143
Indiana	Indiana State Government	http://www.indianabroadbandmap.com/
Iowa	Office of the Chief Information Officer Iowa	https://iowa.maps.arcgis.com/apps/webappviewer/index.html?id=3847e55ad45b4cecb88173d00d6108fe
Kansas	Connected Nation and the Information Network of Kansas (INK)	https://www.arcgis.com/apps/webappviewer/index.html?id=72ab65f4ac2c4207abd1e575fa148cb4
Kentucky	Kentucky Communications Network Authority	https://kentuckywired.ky.gov/cfr/Pages/maps.aspx
Louisiana	Delta Regional Authority	https://dra.gov/about-dra/research-and-data/active-requests-for-proposals/
Maine	ConnectMaine Authority	https://maps.sewall.com/connectme/public/

Maryland	Maryland Broadband Cooperative, Inc.	https://geodata.md.gov/BroadbandMap/
Massachusetts	Massachusetts Broadband Institute at the MassTech Collaborative	https://broadband.masstech.org/latest-news/map-gallery
Michigan	Connected Nation Michigan	https://gis.connectednation.org/portal/apps/webappviewer/index.html?id=98c4d702d00040c9be673787bfeb8162
Minnesota	Minnesota Office of Broadband Development	https://gis.connectednation.org/portal/apps/webappviewer/index.html?id=a2d243ccf7e547eba2ec0d5c80c80917
Mississippi	None	
Missouri	Missouri Department of Economic Development	https://mogov.maps.arcgis.com/apps/webappviewer/index.html?id=8b639ca6db974f5f859a043746336ff5
Montana	State of Montana	https://mslservices.mt.gov/legislative_snapshot/Broadband/Default.aspx#Maps
Nebraska	Nebraska Public Service Commission	https://gis.ne.gov/portal/apps/webappviewer/index.html?id=ba42a254d4f14f4783a14193c12a443e
Nevada	Connect Nevada	https://www.connectnv.org/interactive-map
New Hampshire	New Hampshire Broadband Mapping and Planning Program	https://www.unh.edu/broadband/broadband-mapping
New Jersey	NJ Spotlight	https://www.njspotlightnews.org/2018/12/18-12-10-interactive-map-internet-and-computer-access-across-nj-reflects-a-digital-divide/
New Mexico	NM DoIT Offices of Broadband and Geospatial Technology	https://nmbbmapping.org/mapping/
New York	New York State Broadband Program Office	https://map.nysbroadband.ny.gov/html5viewer/?viewer=broadband
North Carolina	NC DIT Broadband Infrastructure Office	https://experience.arcgis.com/experience/4096f70b64474e85a6646969902e514d
North Dakota	North Dakota IT	https://www.nd.gov/itd/statewide-alliances/broadband
Ohio	Connected Nation Ohio	https://geohio.maps.arcgis.com/apps/MapSeries/index.html?appid=64008bdfcc8041379f74a7d14be72e38
Oklahoma	Oklahoma government	http://broadbandmapping.ok.gov/OKmap.html
Oregon	Oregon Broadband Office	https://geo.maps.arcgis.com/apps/webappviewer/index.html?id=002a3eee6efb48a1868b4494168d730a
Pennsylvania	PennState Extension	https://extension.psu.edu/pennsylvania-broadband-map
Rhode Island	None	None
South Carolina	Office of Regulatory Staff South Carolina	https://scors.maps.arcgis.com/apps/webappviewer/index.html?id=d7465460e69c4966a1bf9722d019c196
South Dakota	South Dakota Bureau of Information and Telecommunications	https://www.arcgis.com/apps/webappviewer/index.html?id=ccd16c24bf804c1fa67d50373d100464

Tennessee	Connected Tennessee	https://www.arcgis.com/apps/webappviewer/index.html?id=821632bdce0f49449164fe1c2def773d
Texas	Connected Nation Texas	https://gis.connectednation.org/portal/apps/webappviewer/index.html?id=9e10c6120228435ca35c759fac3d805e
Utah	Utah Governor's Office of Economic Development	https://broadband.ugrc.utah.gov/
Vermont	State of Vermont Department of Public Service	https://vtpsd.maps.arcgis.com/apps/View/index.html?appid=c47f156cef4a4db0b407333fc5dab63f
Virginia	Virginia Information Technology Agency's Virginia Geographic Information Network	https://broadband.cgit.vt.edu/IntegratedToolbox/
Washington	Washington State Broadband Office	https://www.arcgis.com/apps/opsdashboard/index.html#/4bcf7c77ecac475eb467e9df0028d05b
West Virginia	West Virginia Broadband Enhancement Council	https://broadband.wv.gov/interactive-west-virginia-broadband-map/
Wisconsin	Wisconsin Broadband Office	https://maps.psc.wi.gov/apps/WisconsinBroadbandMap/
Wyoming	Wyoming State Broadband Program, Wyoming Business Council	https://wygisc.maps.arcgis.com/apps/opsdashboard/index.html

NTIA will distribute BEAD funds to the states "based on the updated broadband availability maps to be published by the FCC."[82] Before the new data is available, however, state officials will rely on available FCC Form 477 data.

[82] https://www.federalregister.gov/documents/2022/01/10/2022-00221/infrastructure-investment-and-jobs-act-implementation

Appendix 2: TPI Resources

The Technology Policy Institute has a portfolio of resources to make it easier to understand broadband subsidies in local districts.

A2.1 On Broadband Maps

TPI's "State of Broadband" Report, Jan. 5, 2022.
https://techpolicyinstitute.org/wp-content/uploads/2022/01/TPI_BroadbandStatesPacket.pdf
https://techpolicyinstitute.org/publications/broadband/map/tpi-state-of-broadband-report/

Broadband Availability Update: New FCC Data for December 2020, Nov. 3, 2021. Scott Wallsten.
https://techpolicyinstitute.org/publications/broadband/map/broadband-availability-update-new-fcc-data-for-december-2020/

Using an Index to Target Broadband Subsidies: A Florida Example, Oct. 3, 2021. Scott Wallsten.
https://techpolicyinstitute.org/publications/broadband/map/florida_connectivity_index/

TPI's Broadband Connectivity Index, Sept. 16, 2021. Scott Wallsten.
https://techpolicyinstitute.org/publications/broadband/map/broadband-connectivity-index/

KY, LA and Some Tribal Areas Lead Early Uptake of Emergency Broadband Benefit Program, Jul. 15, 2021. Scott Wallsten.
https://techpolicyinstitute.org/publications/broadband/digital-divide/mapping-the-emergency-broadband-benefit-program/

New Broadband Maps are Coming. They'll Be Useless Unless We Also Invest in Research and Analytical Capacity. Jul. 22, 2020. Sarah Oh and Scott Wallsten.
https://morningconsult.com/opinions/new-broadband-maps-are-coming

A2.2 On Broadband Subsidies and the Digital Divide

How Not to Waste $45 Billion in Broadband Subsidies. Aug. 7, 2021. Gregory Rosston and Scott Wallsten.
https://thehill.com/opinion/finance/566772-how-not-to-waste-45-billion-in-broadband-subsidies

COVID-19 is Narrowing the Digital Divide. Feb. 10, 2021. Scott Wallsten.
https://techpolicyinstitute.org/publications/broadband/covid-19-is-narrowing-the-digital-divide/

Comments filed with the Federal Communications Commission. *In the Matter of the Emergency Broadband Benefit Program*, "Defining Objectives and Measuring Outcomes in the Emergency Broadband Benefit Program," Jan. 26, 2021. Sarah Oh and Scott Wallsten.
https://techpolicyinstitute.org/wp-content/uploads/2021/03/Oh-Wallsten-Comments-on-EBBP-1.pdf

Using Reverse Auctions to Stretch Broadband Subsidy Dollars: Lessons from The Recovery Act of 2009, Jan. 25, 2021. Sarah Oh.
https://techpolicyinstitute.org/publications/broadband/using-reverse-auctions-to-stretch-broadband-subsidy-dollars-lessons-from-the-recovery-act-of-2009/

Increasing Low-Income Broadband Adoption Through Private Incentives. Oct. 2020. Gregory Rosston and Scott Wallsten.
https://www.sciencedirect.com/science/article/abs/pii/S0308596120301129

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https://techpolicyinstitute.org/wp-content/uploads/2022/02/TPI_Comments_to_NTIA_on_BIL.pdf

Comments filed with the Federal Communications Commission. *In the Matter of Establishing a 5G Fund for Rural America and Universal Service Reform – Mobility Fund: Proposal for a 5G USF Research Fund*. Jun. 26, 2020. Sarah Oh.
https://techpolicyinstitute.org/wp-content/uploads/2020/06/Oh-Comments-on-5G-Fund-Proposal-for-a-5G-USF-Research-Fund.pdf

Comments filed with the Federal Communications Commission. *In The Matter of Restoring Internet Freedom, Bridging the Digital Divide for Low Income, and Lifeline and Link Up Reform and Modernization*. Apr. 20, 2020. Scott Wallsten.
https://techpolicyinstitute.org/wp-content/uploads/2020/04/Wallsten-Net-Neutrality-Comments.pdf

Comments filed with the Federal Communications Commission. *In the Matter of Rural Digital Opportunity Fund Auction*. Apr. 10, 2020. Gregory Rosston and Scott Wallsten.
https://techpolicyinstitute.org/wp-content/uploads/2020/04/Rosston-Wallsten-WC-Docket-No.-19-126.pdf

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https://techpolicyinstitute.org/wp-content/uploads/2019/07/Oh_Wallsten_USF072919.pdf

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Does Competition Between Cable and Fiber Increase Adoption? Apr. 27, 2021. Scott Wallsten.

https://techpolicyinstitute.org/wp-content/uploads/2021/05/Does-Competition-Between-Cable-and-Fiber-Increase-Adoption.pdf

Surprise! The FCC Has Been Collecting Broadband Price Data for Years. Apr. 12, 2021. Scott Wallsten.
https://techpolicyinstitute.org/publications/broadband/surprise-the-fcc-has-been-collecting-broadband-price-data-for-years/

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https://techpolicyinstitute.org/publications/broadband/youve-been-served-defining-broadband-as-100-100-is-not-100/

Municipal Broadband is a Bad Idea for Cash-Strapped Towns. Jan. 16, 2021. Sarah Oh.
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What are the Economic Effects of Municipal Broadband? Nov. 5, 2019. Sarah Oh.
https://techpolicyinstitute.org/publications/broadband/what-are-the-economic-effects-of-municipal-broadband/

A2.4 Two Think Minimum Podcasts

Blair Levin and Gregory Rosston on Broadband Subsidies, Jan. 18, 2022.
https://techpolicyinstitute.org/publications/broadband/blair-levin-gregory-rosston-on-broadband-subsidies/

Gus Hurwitz on The Rural Digital Divide and Platforms, Feb. 8, 2021.
https://techpolicyinstitute.org/publications/broadband/digital-divide/gus-hurwitz-on-the-rural-digital-divide-and-platforms/

Stanford's Greg Rosston on The Future of Broadband Accessibility, Jan. 22, 2021.
https://techpolicyinstitute.org/publications/broadband/stanfords-greg-rosston-on-the-future-of-broadband-accessibility/

Building on What Works: An Analysis of U.S. Broadband Policy with Jonathan Nuechterlein and Howard Shelanski, Dec. 29, 2020.
https://techpolicyinstitute.org/publications/broadband/building-on-what-works-an-analysis-of-us-broadband-policy-with-jonathan-nuechterlein-shelanski/

Looking Back on Ten Years of the National Broadband Plan with Blair Levin. Mar. 24, 2020. https://techpolicyinstitute.org/publications/broadband/spectrum-and-wireless/looking-back-on-ten-years-of-the-national-broadband-plan-with-blair-levin-two-think-minimum/

A2.5 Mapping Analysis Tools

TPI's Broadband Map with Regression Tools and State-by-State Map Views. 2021-2022.
https://tpibroadband.com
https://tpibroadband.com/state/
https://broadband.tools

Where Are E-Rate Dollars Going? Introducing E-Rate Intelligence. Jun. 3, 2021.
https://techpolicyinstitute.org/publications/broadband/where-are-e-rate-dollars-going-introducing-e-rate-intelligence/
https://tpireports.com

A2.6 TPI Aspen Forum Panels

How Should We Spend $100 Billion on Broadband? 2021 TPI Aspen Forum. Aug. 16, 2021.
https://www.youtube.com/watch?v=op5gWUTbfzI

A Discussion with North American Telecom Regulators. 2021 TPI Aspen Forum. Aug. 17, 2021.
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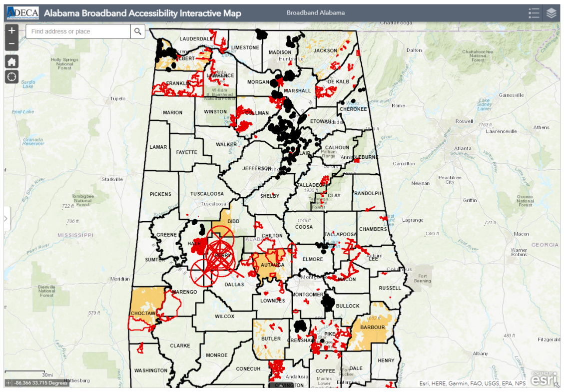
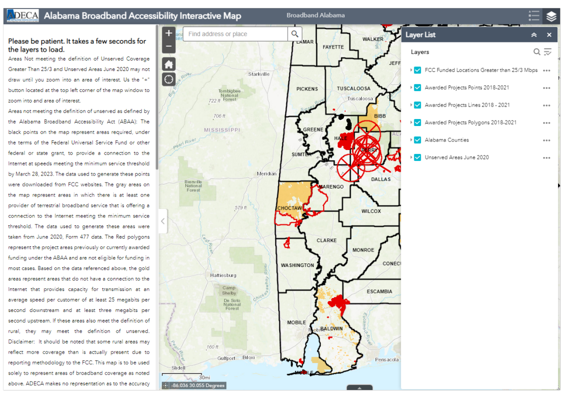
Appendix 4: Compendium of State Broadband Maps

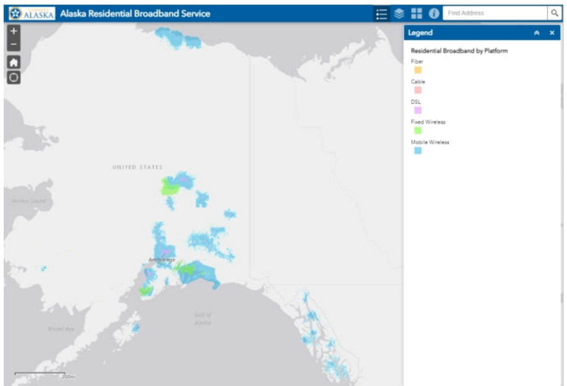
1 Alabama





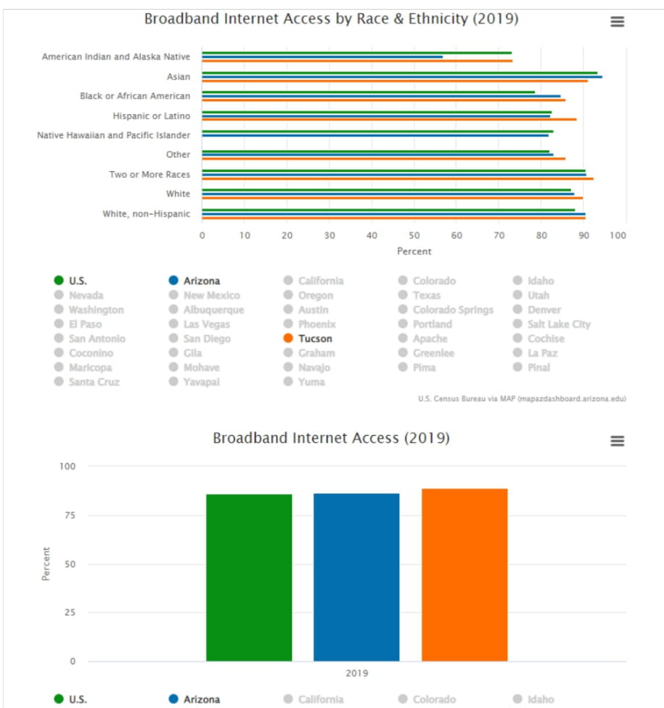
Source: Alabama Department of Economic and Community Affairs

2 Alaska



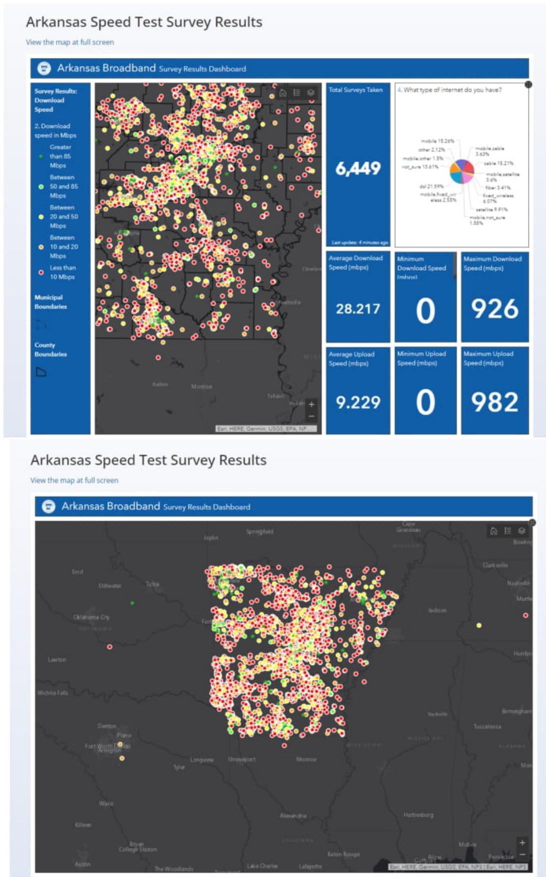
Source: Connect Alaska

3 Arizona

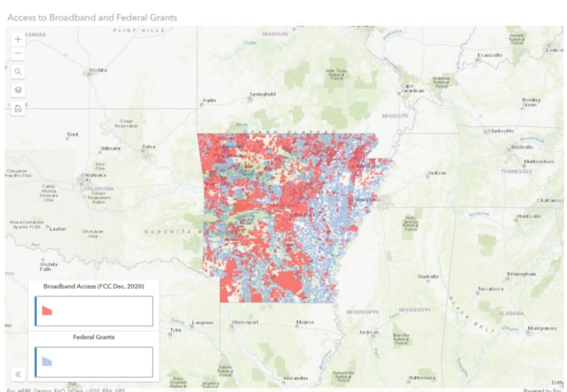


Source: Making Action Possible for Southern Arizona (Static map)

4 Arkansas

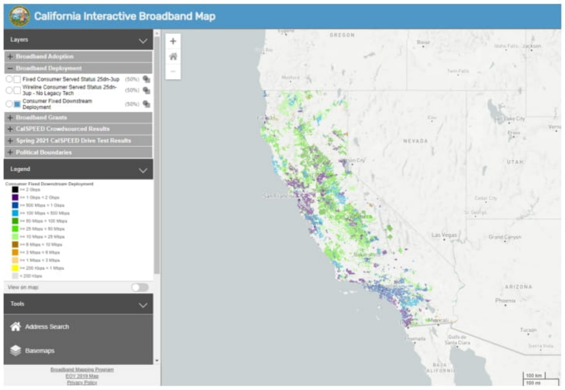


Source: Arkansas State Broadband Office - Arkansas Rural Connect



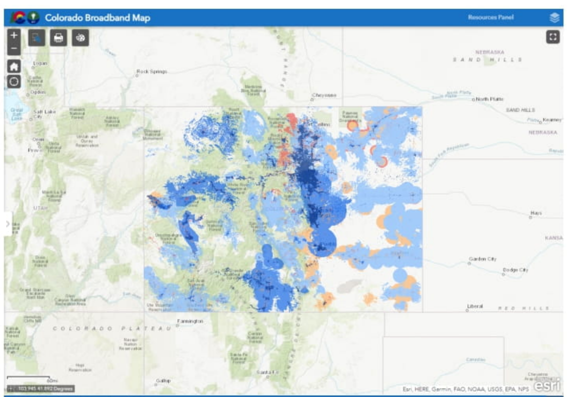
Source: Arkansas Department of Commerce Broadband Office

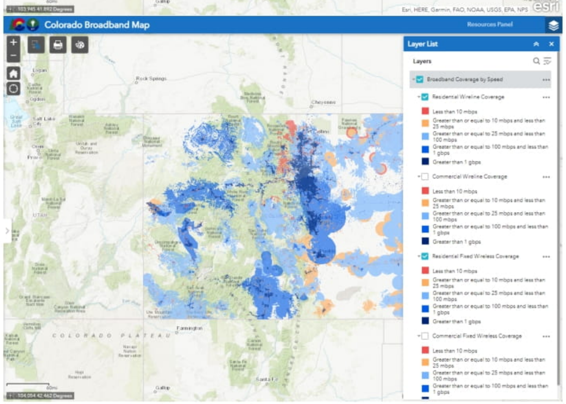
5 California



Source: California Public Utilities Commission

6 Colorado





Source: Colorado Broadband Office

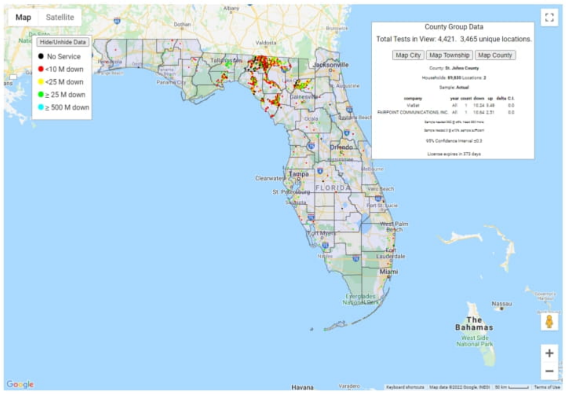
7 Connecticut

No map

8 Delaware

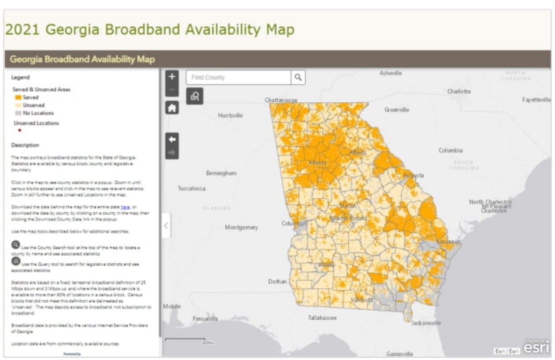
No map

9 Florida



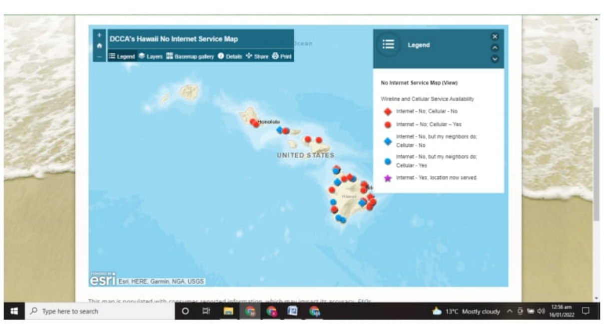
Source: Florida Office of Broadband

10 Georgia



Source: Georgia Department of Community Affairs

11 Hawaii



Source: Hawaii Department of Commerce and Consumer Affairs - Broadband

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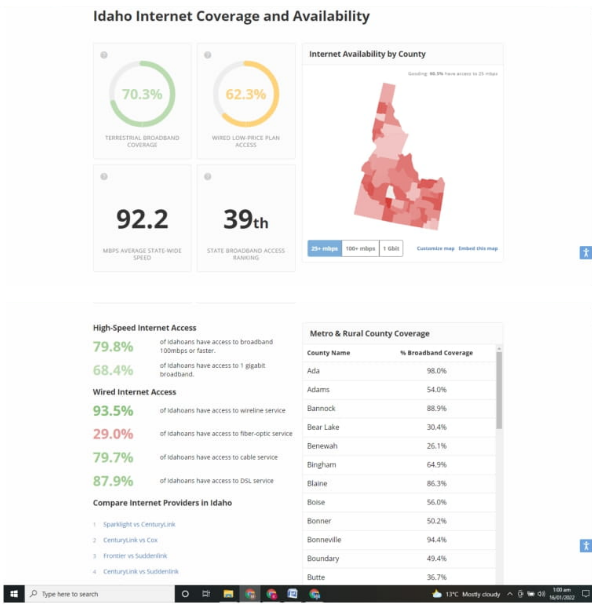
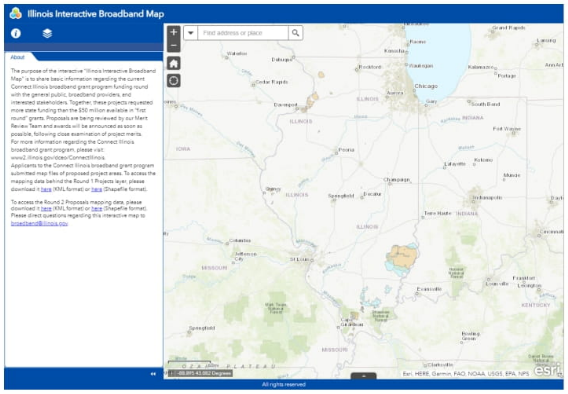
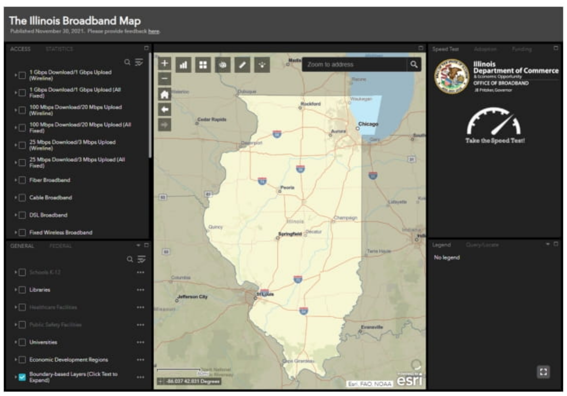


Source: BroadbandNow

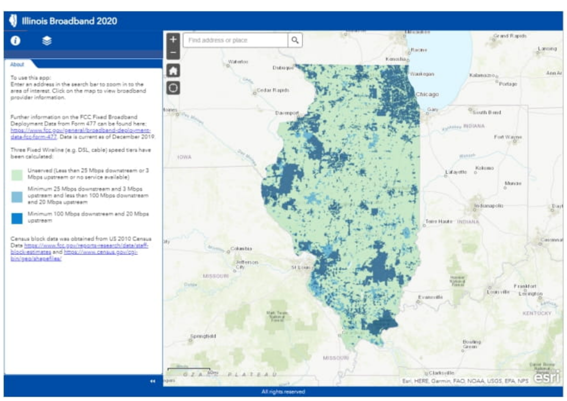
13 Illinois



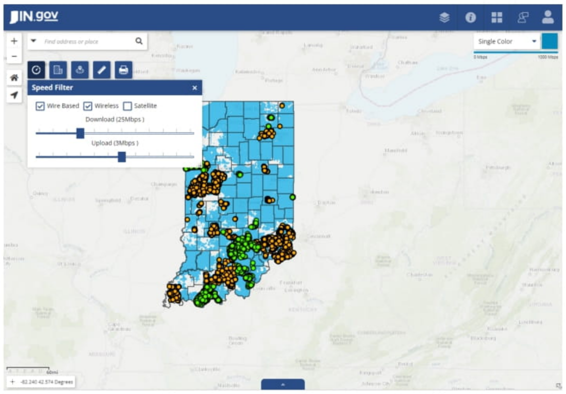
Source: Connect Illinois



Source: Illinois Office of Broadband + Connected Nation

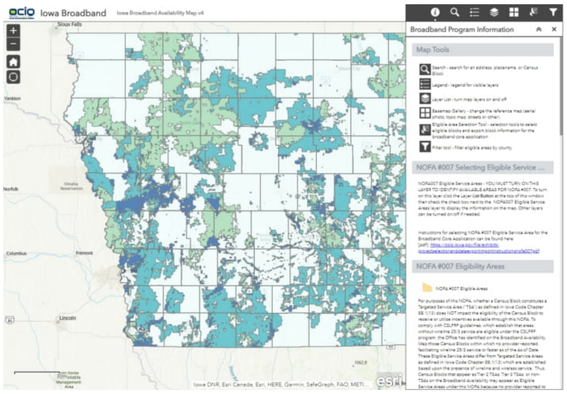


14 Indiana



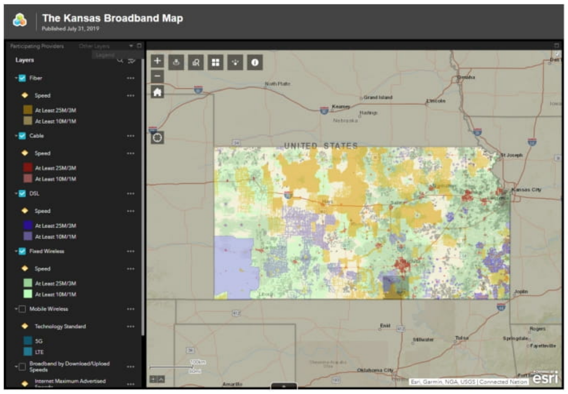
Source: Indiana government via 39 Degrees North

15 Iowa



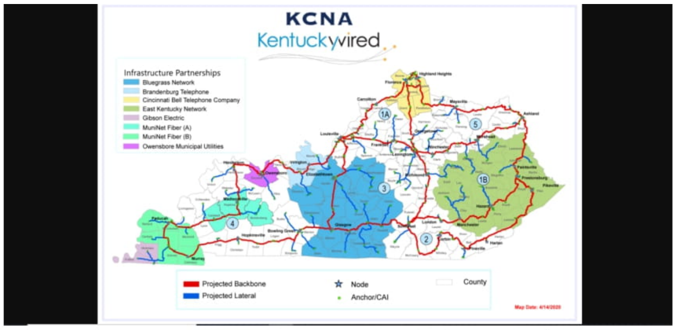
Source: Office of the Chief Information Officer Iowa

16 Kansas



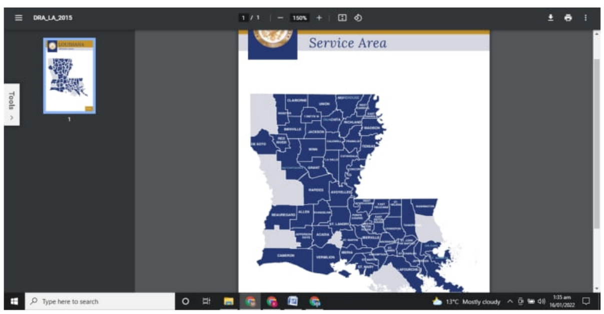
Source: Connected Nation and the Information Network of Kansas

17 Kentucky



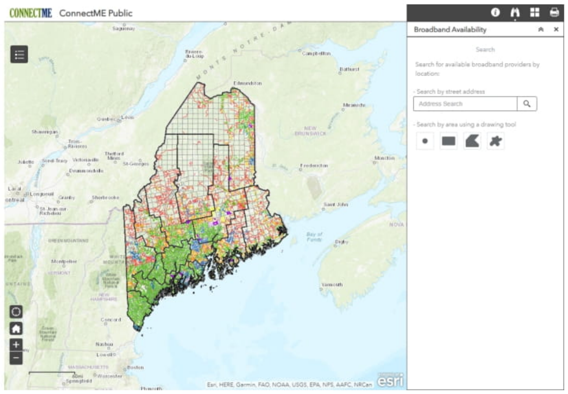
Source: Kentucky Communications Network Authority (Static map)

18 Louisiana



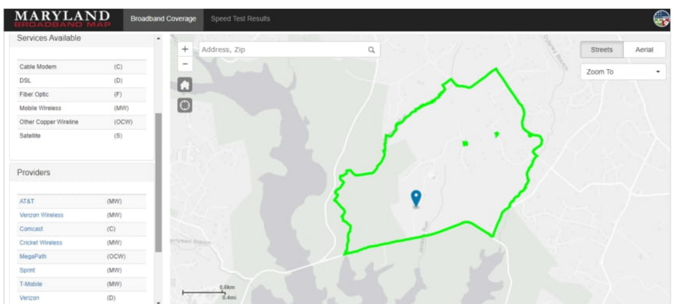
Source: Delta Regional Authority (Static map)

19 Maine



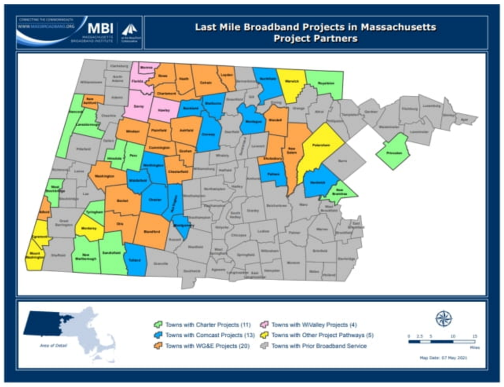
Source: ConnectMaine Authority

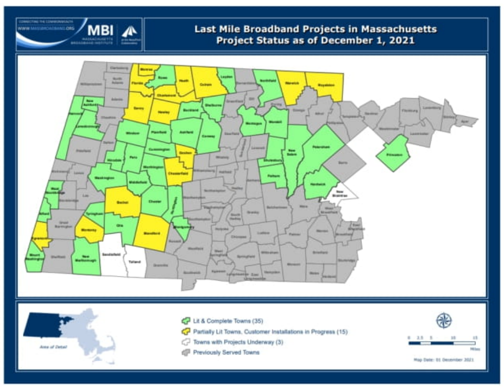
20 Maryland



Source: Maryland Broadband Cooperative, Inc.

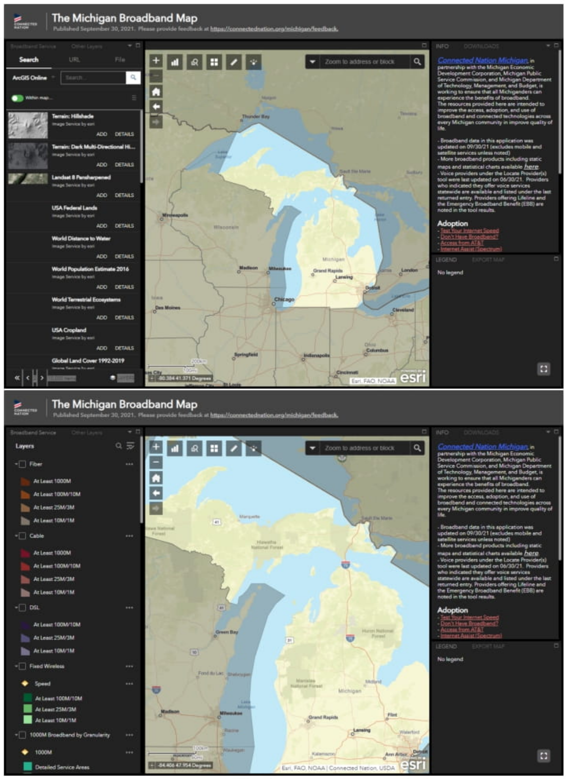
21 Massachusetts





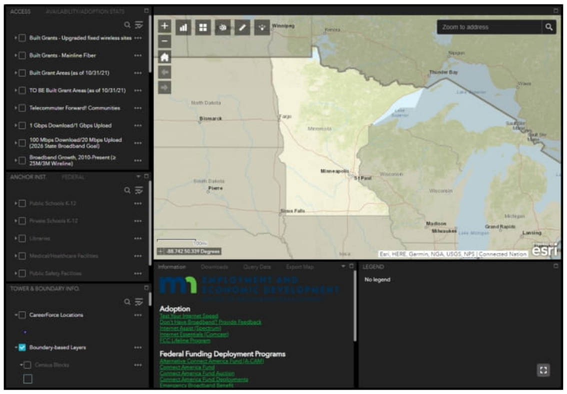
Source: Massachusetts Broadband Institute at the MassTech Collaborative
(Static maps)

22 Michigan



Source: Connected Nation Michigan

23 Minnesota

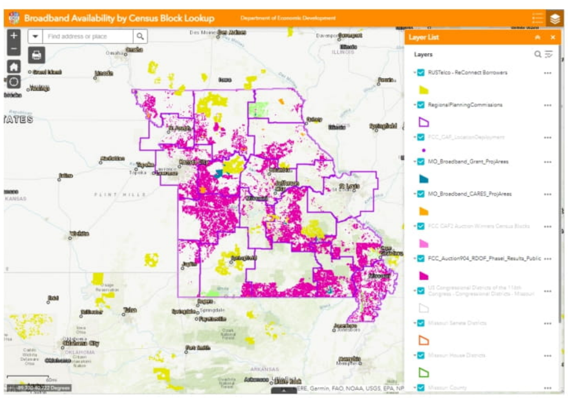


Source: Minnesota Office of Broadband Development

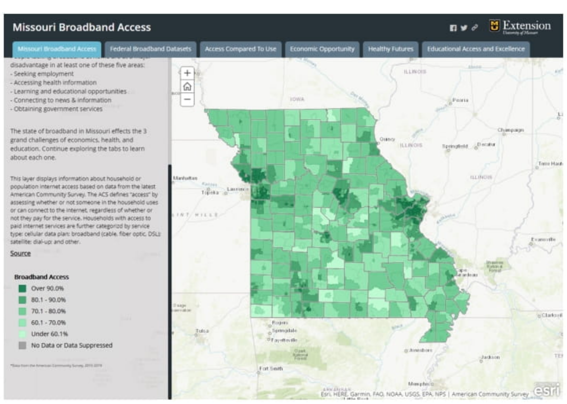
24 Mississippi

No map

25 Missouri



Source: Missouri Department of Economic Development

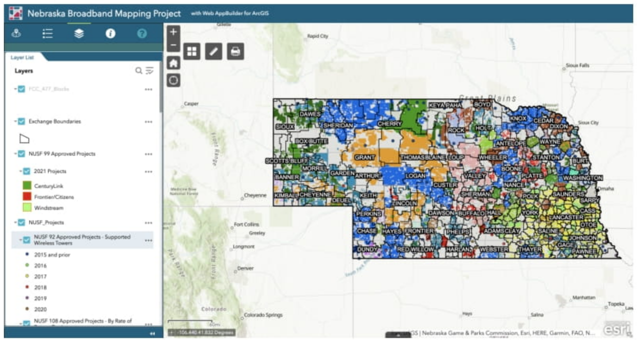


Source: University of Missouri

26 Montana

No interactive map

27 Nebraska



Source: Nebraska Public Service Commission

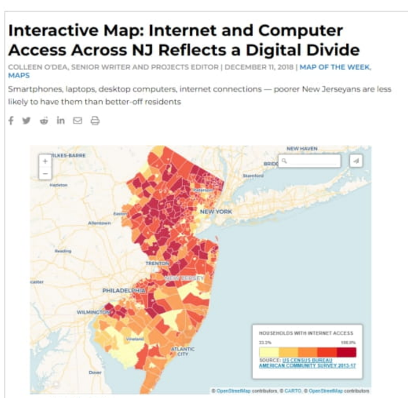
28 Nevada

Map link currently not working
Source: Connect Nevada

29 New Hampshire

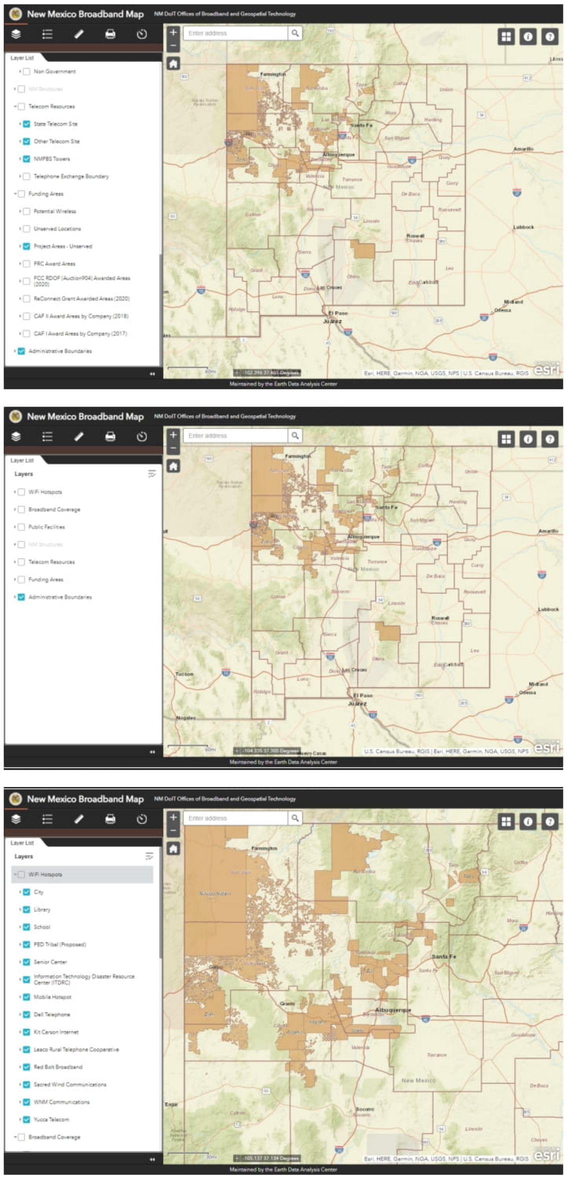
Map link currently not working
Source: New Hampshire Broadband Mapping and Planning Program

30 New Jersey



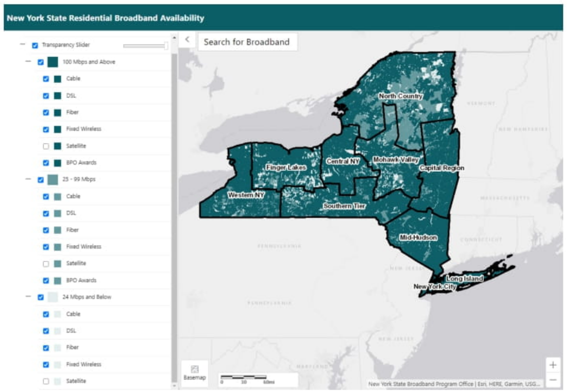
Source: NJ Spotlight

31 New Mexico



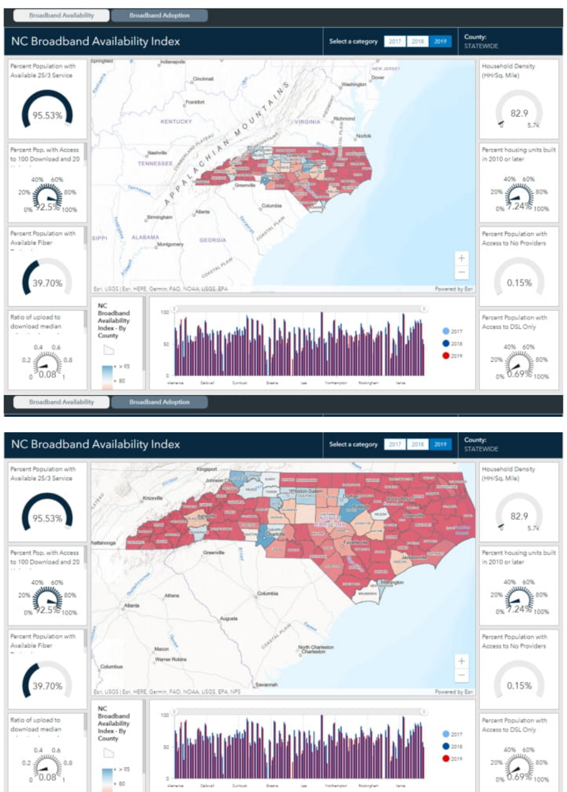
Source: NM DoIT Offices of Broadband and Geospatial Technology

32 New York

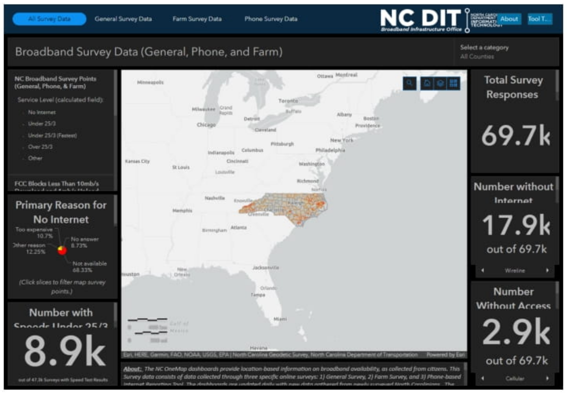


Source: New York State Broadband Program Office

33 North Carolina



Source: NC DIT Broadband Infrastructure Office

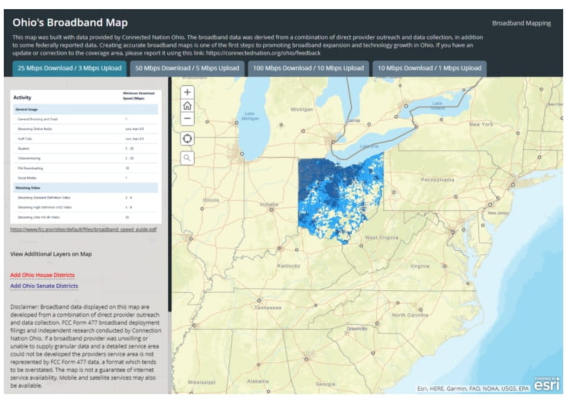


Source: NC DIT Broadband Infrastructure Office

34 North Dakota

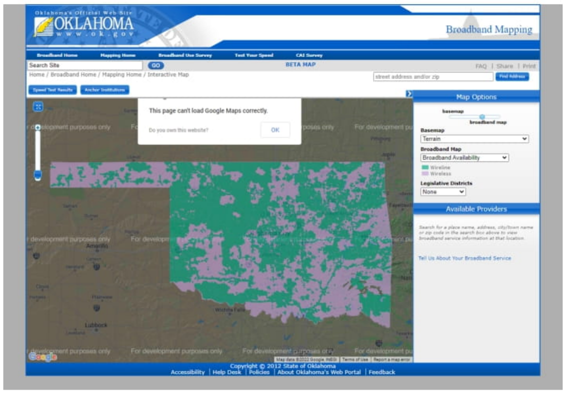
Map link currently not working
Source: ND IT

35 Ohio

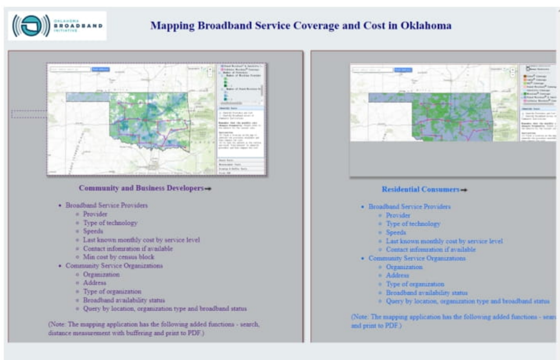


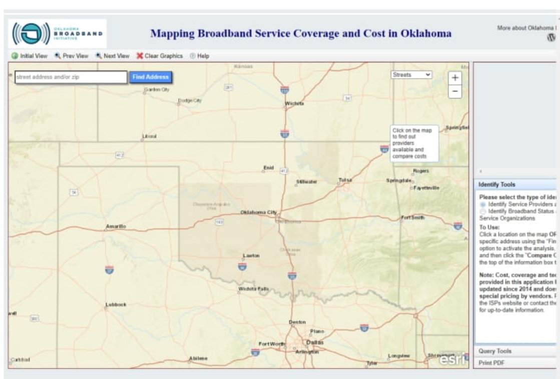
Source: Connected Nation Ohio

36 Oklahoma



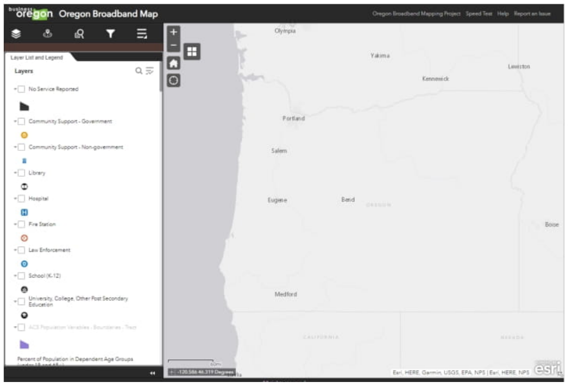
Source: State of Oklahoma

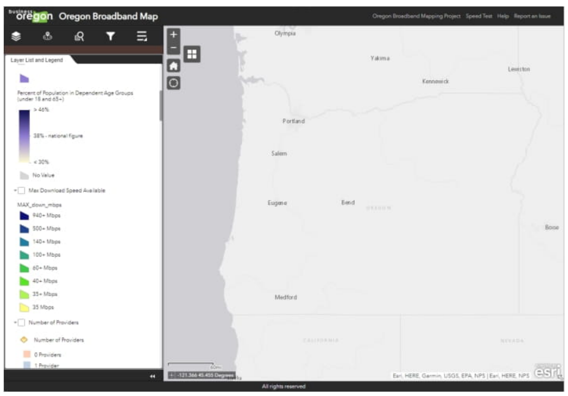




Source: Oklahoma Broadband Initiative, the University of Oklahoma, Center of Spatial Analysis

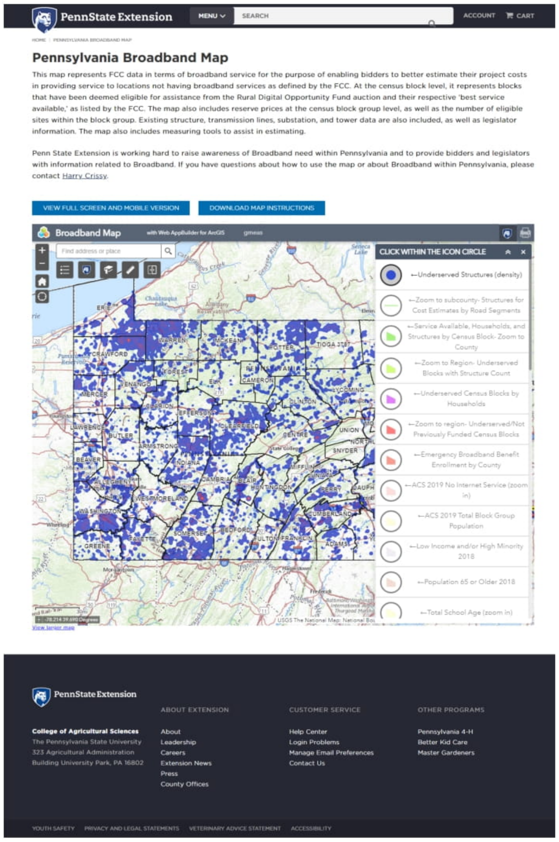
37 Oregon





Source: Oregon Broadband Office

38 Pennsylvania

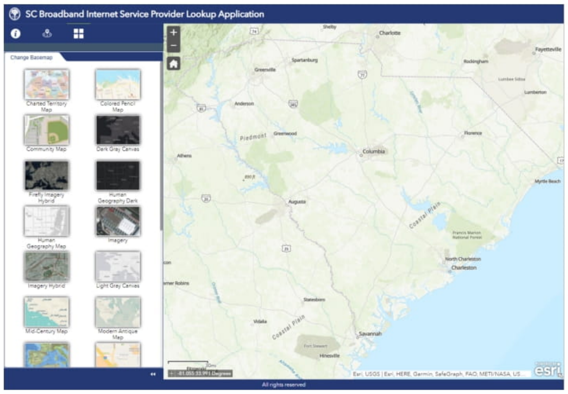


Source: PennState Extension

39 Rhode Island

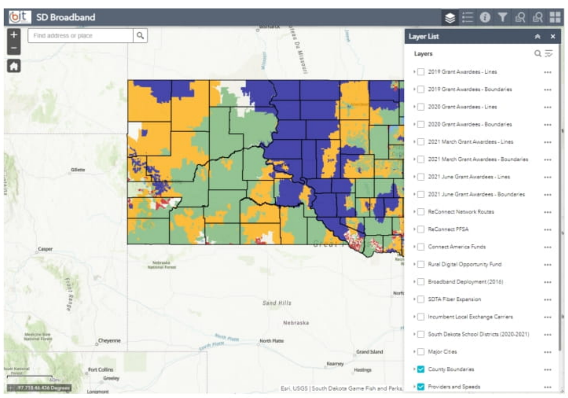
No map

40 South Carolina



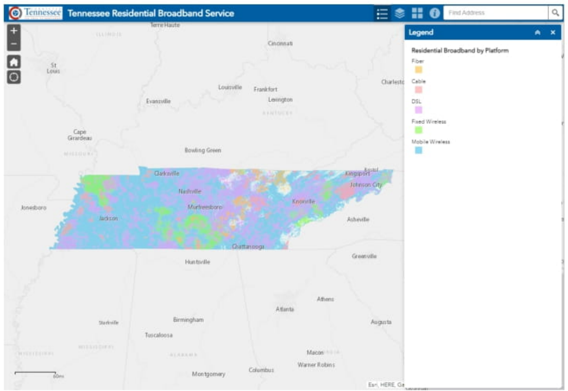
Source: Office of Regulatory Staff South Carolina

41 South Dakota



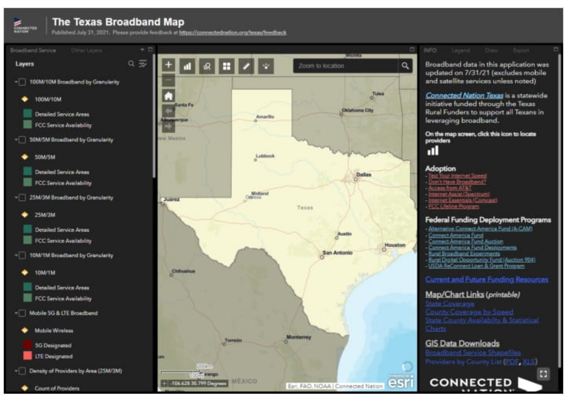
Source: South Dakota Buerau of Information and Telecommunications

42 Tennessee



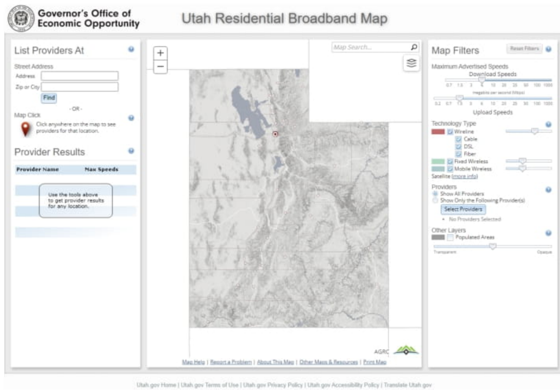
Source: Connected Tennessee

43 Texas



Source: Connected Nation Texas

44 Utah

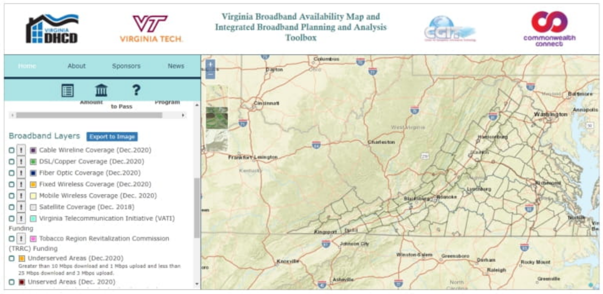


Source: Utah Governor's Office of Economic Development

45 Vermont

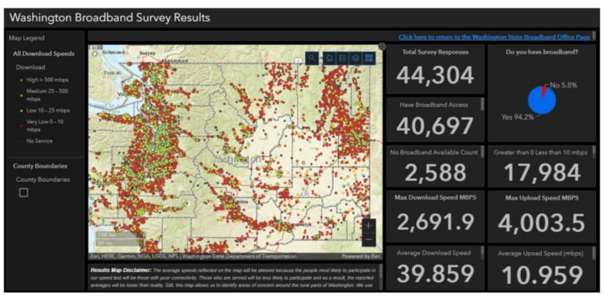
Source: State of Vermont Department of Public Service

46 Virginia



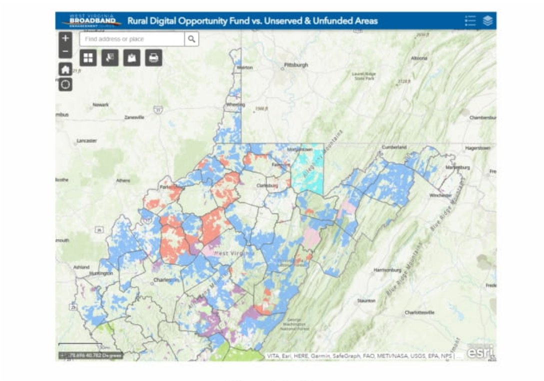
Source: Office of Telework Promotion and Broadband Assistance, Virginia Tech's Center for Geospatial Information Technology, Virginia Information Technology Agency's Virginia Geographic Information Network

47 Washington



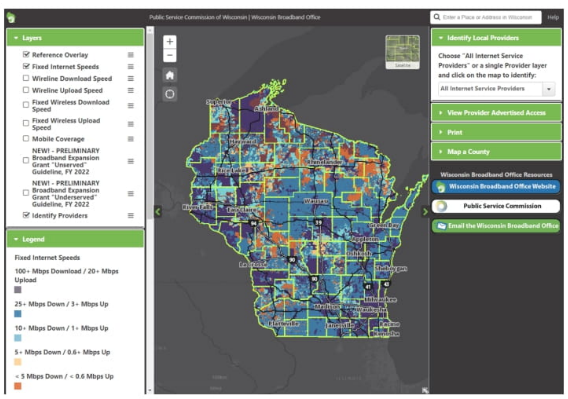
Source: Washington State Broadband Office

48 West Virginia



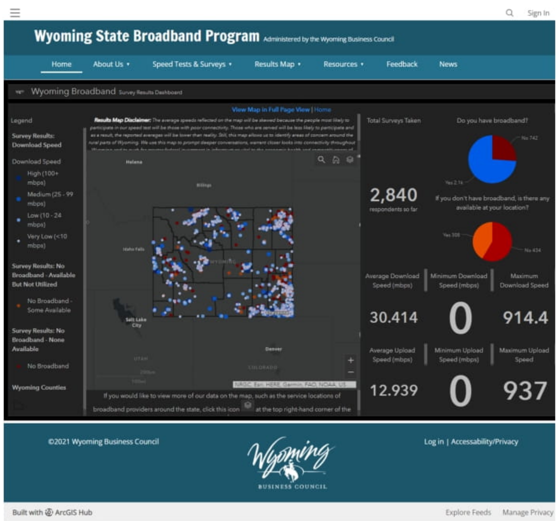
Source: West Virginia Broadband Enhancement Council

49 Wisconsin



Source: Wisconsin Broadband Office

50 Wyoming



Source: Wyoming State Broadband Program