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Lessons from the Recovery Act of 2009

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Twelve years ago, the federal government awarded hundreds of grants for broadband infrastructure with stimulus funds from the Recovery Act of 2009. In this study, I review the subsidy allocations from the Broadband Technology Opportunities Program and compare actual outcomes with those that a reverse auction or random lottery may have yielded. My analysis shows that a reverse auction might have connected nearly twice as many buildings for the same total subsidy dollars relative to the results from the grant review process. Moreover, the grant review process used by the NTIA did only slightly better in subsidy-dollars-per-building-connected than a random lottery probably would have. Lessons from the Recovery Act are drawn from public data on proposed and awarded projects from application files for stimulus funds. I conclude that the government likely overpaid for broadband by using grant review rather than a reverse auction. The analysis strongly implies that future broadband grants be distributed using market-based methods to get better returns on investment from infrastructure funds.

Keywords: broadband infrastructure, reverse auctions

JEL Classification: H30, H42, K23, L50, L96

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Introduction

The U.S. government used a grant review process to select broadband infrastructure projects in the American Recovery and Reinvestment Act of 2009 (Recovery Act).[1] In this study, I ask whether a reverse auction might have yielded better results from $3.4 billion in stimulus funds.

Two months after the Recovery Act was signed into law, 71 economists sent a letter to the Department of Commerce recommending that the agency use a reverse auction instead of a traditional grant review process to distribute stimulus funds.[2] The economists warned that without the cost discipline of competitive bidding, the government would likely spend the funds inefficiently.[3] With data from the application files, we can assess the economists' recommendation years later. Would a reverse auction have been more efficient than grant review to distribute funds in the Broadband Technology Opportunities Program (BTOP)?

To answer this question, I collected each of the project's expected costs as described in their grant applications in order to estimate the unit costs for connecting buildings and installing fiber. Then, I ran a counterfactual analysis to compare the selected projects from the grant review process with those that could have been selected with a reverse auction or a lottery. I found that a reverse auction may have connected nearly twice as many buildings as were connected through the grant review process.

This study proceeds as follows. Section 1 describes details of the BTOP program. Section 2 describes the counterfactual analysis that compares grant review, reverse auctions, and a lottery. A discussion of subsidy allocations and lessons for future infrastructure programs follows.

1. Broadband Subsidies in the Recovery Act

This section describes how broadband grants were awarded in 2009.

A. Process

Congress directed the National Telecommunications and Information Administration (NTIA) to distribute money allocated for broadband infrastructure in the Recovery Act. NTIA awarded stimulus funds to 123 projects after receiving over a thousand applications for middle-mile and last-mile broadband projects in the Comprehensive Community Infrastructure portion of the Broadband

1 American Reinvestment and Recovery Act of 2009 (ARRA) (Pub. L. 111-5) (Feb. 17, 2009), https://www.congress.gov/111/plaws/publ5/PLAW-111publ5.pdf. The Broadband Technology Opportunities Program (BTOP) was allocated $4.7 billion (later decreased to $4.4 billion) of $787 billion in total stimulus funds as specified in 47 U.S.C. 1305, S. 6000. This study focuses on projects in the $3.4 billion section of the broadband program for Comprehensive Community Infrastructure dedicated to middle-mile broadband.
2 Seventy-one economists signed a letter to remind administrators that market mechanisms could more efficiently allocate funds for infrastructure projects than traditional grant review. See Comments of 71 Concerned Economists. 2009. "Using Procurement Auctions to Allocate Broadband Stimulus Grants," https://ssrn.com/abstract=1377523.
3 Id. at 3. ("Reviewing grant applications is not an appropriate way to distribute broadband stimulus grants."). Id. at 2. ("[I]t will be difficult to choose between, say, a fiber project in Texas and a wireless project in North Dakota.").

Technology Opportunities Program (BTOP).[4] NTIA did not use competitive bidding to choose these projects. Instead, applications were read, evaluated, and scored by a team of reviewers based on qualitative and quantitative selection criteria. Forty civil servants, with the help of consultants from the private and non-profit sectors, read thousands of application files. Application files included narratives and specifications for proposed projects on a template designed by grant administrators.[5]

In order to conduct the review process, NTIA borrowed grant officers from other federal agencies and recruited non-government volunteers to read the applications. Two volunteer reviewers read each file.[6] This number was revised downward from three after volunteers quit.[7] In a Senate oversight hearing,[8] one senator commented on the ungainly effort, "NTIA ha[d] not previously managed a grant program of BTOP's size and complexity."[9]

B. Selection Criteria

Each proposal was scored based on qualitative assessments of project purpose (30 points), benefits (25 points), viability (25 points), and budget and sustainability (20 points).[10] Reviewers were asked to refer to a list of priorities to evaluate proposals, but publicly released guidance does not make it clear how these priorities were scored. The seven priorities were, (1) commitment to anchor institutions, (2) public-private partnerships, (3) economically distressed communities, (4) commitment to community colleges, (5) commitment to public safety entities, (6) last-mile components, and (7) over a 30 percent match in funds from other funding sources.[11]

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4 The total applicant pool for infrastructure grants included 773 grant proposals included in my dataset and 239 more applications in the middle-mile category which were missing from public files by Easy Grant number. Several projects were not included in publicly available files. My dataset includes data on 116 projects (N=116).

5 Letters from local, state, and federal politicians, school board members, hospital administrators, and local business owners were included in the application packets.

6 The use of volunteer reviewers may have violated the Anti-Deficiency Act. See Office of the Inspector General. 2020. "NTIA Must Continue to Improve Its Program Management and Pre-Award Process for its Broadband Grants Program," OIG Report No. ARR-19842-1, https://www.oig.doc.gov/OIGPublications/ARR-19842.pdf. Federal agencies use peer review in different ways to award grants. The National Science Foundation uses three to ten external reviewers, while the National Institutes of Health uses eighteen to twenty external reviewers.

7 Id. ("The personnel shortage was compounded by a lack of qualified individuals applying to become reviewers, reviewers who dropped out of the process, and the time it took to successfully review the often very lengthy applications (at times over 1,000 pages).").

8 Oversight of the Dept. of Commerce's Broadband Technology Opportunities Program, Hearing Before a Subcommittee of the Committee on Appropriations, U.S. Senate, 111th Cong. 2nd, S. Hrg. 111-698, Jan. 28, 2010 ("NTIA, with billions of dollars, has been besieged with great proposals, grand proposals. The smallest agency in the Department of Commerce is now tasked with funding $4.7 billion in grants. And yet the administration, Mr. Secretary, overestimated NTIA's capacity to deliver this funding and tasked an agency that does not even have a grant administrating office with disbursing $4.7 billion.... Further, panels of outside contractors have been hired to review applications. Many of these contractors have never been interviewed in person by anyone at the Department of Commerce and yet are responsible for ensuring that all applicants are qualified.").

9 The National Institutes of Health, by contrast, reviews $16 billion of grants per year. See generally Powell, Kendall, "Making the Cut," Nature, 467: 383 (2010). Cole, Jonathan, R., and Stephen Cole, "Will the Researcher Get the Grant?" Nature, 279: 575 (1979).

NTIA, Round 1 Workshops. See http://www2.ntia.doc.gov/documents/Infrastructure2_0721.pdf.

NTIA, Round 2 Workshops. See http://www2.ntia.doc.gov/documents/BTOPSuccessfulApplicationPPT.pdf.

10 NTIA, Round 1 Workshops. See http://www2.ntia.doc.gov/documents/Infrastructure2_0721.pdf

11 NTIA, Round 2 Workshops. See http://www2.ntia.doc.gov/documents/BTOPSuccessfulApplicationPPT.pdf.

Budget size was included in the selection criteria with consideration of "eligible costs," which the agency defined as (1) reasonable, (2) necessary, (3) allocable, and (4) appropriate.[12] The selection criteria did not explicitly take into consideration cost effectiveness. One way to compare projects on cost effectiveness would have been to list the unit costs for each of the network components in the application narratives. Estimates of unit costs could have been calculated for each network component such as buildings connected or fiber miles installed. This calculation of unit cost might have been implicit in consideration of "eligible costs," but was not spelled out in the selection criteria. It is possible that low-cost bids received more points because low costs may have been more "reasonable," "necessary," or "appropriate," but whether low-cost bids got more weight is unclear from the scoring rubric. "Viability" or "budget and sustainability" in the scoring system may also have been used by reviewers to incorporate cost effectiveness, although it is unclear if that is how reviewers scored proposed costs.

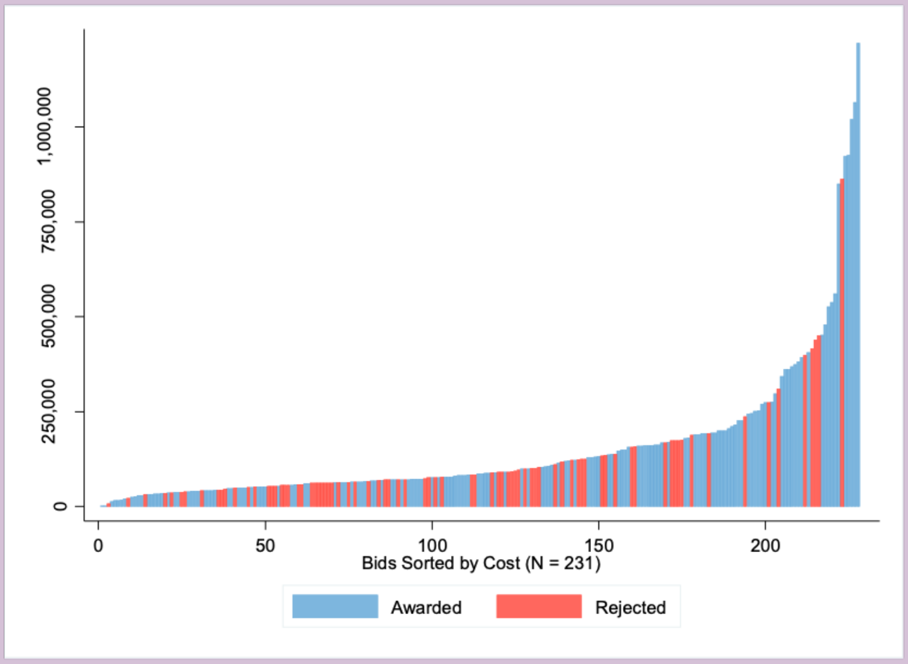
Congress capped the maximum subsidy per project at $500 million. The statute also mandated that each state would receive at least one infrastructure grant.[13] I refer to this statutory provision as the "one-project-per-state rule" (1PPS) for purposes of this study. Because fiscal stimulus was meant to be "temporary, timely, and targeted," the Recovery Act set a strict deadline for the government to spend stimulus funds by September 10, 2010.[14] If grantees could not complete their proposed projects, they had a duty under federal law to return the money.[15]

C. Outcome

Figure 1 shows rejected and awarded projects. The projects are rank ordered by proposed unit costs for fiber miles. The figure shows that some projects with significantly higher unit costs were selected over projects with lower expected unit costs, according to my estimates of cost-per-fiber-mile.

12 NTIA, Round 1 Workshops. See http://www2.ntia.doc.gov/documents/Infrastructure1_0721.pdf. See also NTIA, Applicant Frequently Asked Questions, May 2010. See http://www2.ntia.doc.gov/files/nofa2_faqs_5_28_10.pdf.
13 47 U.S.C. 1305, https://www.congress.gov/111/plaws/publ5/PLAW-111publ5.pdf.
14 Concerned Economists, at 1.
15 Ten out of 123 projects were terminated early for failure to fulfill proposed buildout goals.

Figure 1. Proposed Projects Sorted by Estimated Cost-Per-Fiber-Mile



My cost-per-fiber-mile estimates are simple calculations of subsidy amount requested (and granted in the case of winners) divided by the number of fiber miles that grantees proposed to install in each application. To compare unit costs in a standardized manner, however, a more sophisticated model would need to control for variation in engineering specifications across fiber deployments.[16] But according to my simple estimates, I found that applicants offered to install an average of 602 fiber miles per project, with winning projects promising to install an average of 679 fiber miles. A simple average of cost-per-fiber-mile of proposed projects was $55,253 and of winning projects was $61,462.[17]

Congress did not direct the NTIA to minimize unit costs in the BTOP program, possibly because engineering tradeoffs can overwhelm a central planner's ability to compare prices. Unit costs for broadband deployment vary widely. Industry analysts at the time estimated that costs range from $3,000 to $42,000 per-fiber-mile in urban areas,[18] with deployment costs as high as $152,000 to $501,600 per-fiber-mile in suburban areas due to regulatory costs from zoning and permitting approvals.[19]

16 The Department of Transportation Intelligent Transportation Systems Joint Program Office publishes estimates of fiber deployments with respect to strand-count and miles of connections, revealing highly variable costs depending on local terrain and zoning constraints. ITS Deployment Evaluation, https://www.itskrs.its.dot.gov/deployment (search results for "fiber miles" include a library of reports for fiber deployments and cost estimates per mile).

17 N = 231, s.d. $760,706, ranging from $155 to $9,935,040 per-fiber-mile. Of 773 applications with EasyGrant numbers, only 231 applications had total budget and total fiber miles listed in their executive summaries. Descriptive statistics of the bids also show that average cost-per-building was $234,201 per-building (N = 402, s.d. $567,880, ranging from $596 to $8,463,393) while average total budget was $40.3 million (N = 452).

18 National Broadband Plan. 2010. http://www.broadband.gov/plan/6-infrastructure/ (citing Gates Foundation and industry reports estimating costs of up to $100,000 per-fiber-mile due to zoning and administrative costs). See Bill and Melinda Gates Foundation, "Preliminary Cost Estimates on Connecting Anchor Institutions to Fiber," September 25, 2009. See https://apps.fcc.gov/edocs_public/attachmatch/ DA-09-2194A1.pdf; Schools, Health, and Libraries Coalition, "Cost of Building Fiber to America's Anchors," September 2009, https://ecfsapi.fcc.gov/file/ 7020243815.pdf.

19 In New Jersey, the Department of Treasury estimated cost-per-fiber-mile from $184,800 to $501,600 per-fiber-mile, with contracts set to $152,000 per-fiber-mile. New Jersey Department of Treasury Application.

In unserved and underserved areas, providers can face higher costs per connection due to the remote distance and challenging topographic features of the last mile. In urban and suburban areas, unit costs may theoretically be lower with hybrid deployments with aerial and buried lines, lateral or backbone connections, and fewer or higher strand counts, but in actuality, regulatory constraints such as zoning and permits may increase unit costs in more populous areas with many property rights holders. Even if Congress had asked NTIA to compare prices, administrators may not have been able to reasonably compare unit costs based solely on self-reported information in grant applications without a market mechanism such as a reverse auction.[20]

Congress could have directed NTIA or the FCC to run a reverse auction according to established methods used in the Universal Service Fund. The mechanics of a reverse auction could have mitigated weaknesses of self-reported costs while promoting price competition. The remainder of this paper evaluates whether alternative subsidy allocation methods such a reverse auction could have yielded a more cost-effective outcome.

Rather than a grant process, the government could have allocated stimulus funds using a reverse auction. To understand the difference in possible allocation methods, I simulated possible outcomes from a reverse auction with and without the one-project-per-state rule. As a baseline comparison, I also simulated a lottery to compare outcomes to simple random chance. Although a lottery is unlikely to be used in practice, it would have saved time and much of the $99 million spent to pay contractors to manage the paperwork of the BTOP program.[21] Historically, lotteries have been used for federal resource allocation, such as in spectrum allocations, although they are rarely used today.[22]

2. Analysis of Alternative Subsidy Allocation Methods

A. Reverse Auctions

In their letter in support of reverse auctions, the 71 economists cited benefits of reverse auctions to identify suppliers who could "provide the good or service for the smallest amount of money."[23] They noted the government's experience in procuring complex weapons systems using competitive bidding based on low-price bids.[24] With procurement auctions, subsidy amounts can be discovered through competition, rather than self-reported by applicants.

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20 The USF's minimum eligible threshold requirements and compliance framework has been established over many years in order to mitigate these information problems in comparing buildout costs across providers and areas.
21 The $99 million in consultant fees could have been spent on an additional 1,980 fiber miles (at $50,000 per-fiber-mile) or 990 schools (at $100,000 per-building).
22 See FCC Report to Congress on Spectrum Auctions, 1997, http://wireless.fcc.gov/auctions/data/papersAnd Studies/fc970353.pdf (for a history of comparative hearings, lotteries, and auctions); FCC Spectrum Auctions, http://wireless.fcc.gov/releases/JV_speech_4_2_03.pdf (the FCC used lotteries with random assignment in 1984 for cellular licenses, when it received 385,000 applications for 642 licenses).
23 Id. at 3.
24 Id.

The economists noted that the Federal Communications Commission (FCC) had experience implementing a reverse auction in the Mobility Fund program after reforms to the Universal Service Fund.[25] Wallsten (2013) reviewed the efficacy of the Mobility Fund auction and found significantly lower costs for network buildout under the cost-per-road-mile bid system. He showed that in areas with multiple bidders, the reverse auction resulted in prices that were substantially lower for broadband infrastructure.[26] Rosston and Wallsten (2014) also noted that without an auction mechanism, a one-time fund, such as a broadband stimulus fund, would not be able to provide conditions for price competition.[27] An auction mechanism, particularly a reverse auction, introduces price competition where the bidder with the lowest bid wins the contract. Telecommunications providers today regularly compete for subsidies after the FCC implemented a bidding system that incorporated price competition in unit costs by cost-per-road-mile to build wireless networks along roadways in rural areas.

In the years since 2009, the FCC has increased its expertise with running reverse auctions to distribute broadband subsidies. Billions of dollars of broadband subsidies have been distributed through reverse auction, with notable examples of the Connect America Fund (CAF) Phase II auction in 2018 and recent Rural Digital Opportunity Fund (RDOF) auction in 2020.[28]

B. Empirical Strategy

In order to conduct a counterfactual analysis, I first collected data on expected costs from the grant proposals submitted to the BTOP infrastructure program. They are no longer available online for public viewing, but while they were, I downloaded all the one-page executive summaries from 773 applications. An additional 239 applications were never made public.[29]

25 The Mobility Fund Phase I (Auction 901) auction of the Universal Service Fund incorporated reforms that allow for funds to go to areas in the country that could use it first, see https://www.fcc.gov/auction/901. See also Wallsten, Scott. 2009. Reverse Auctions and Universal Telecommunications Service: Lessons from Global Experience, Federal Communications Law Journal, 61(2): 373-394.
26 Wallsten, Scott. 2013. "Two Cheers for the FCC's Mobility Fund Reverse Auction." Journal on Telecommunications and High Technology Law, 11: 369-388.
27 Rosston, Gregory L., and Scott J. Wallsten. 2014. "The Broadband Stimulus: A Rural Boondoggle and a Missed Opportunity." I/S: A Journal of Law and Policy for the Information Society, 9(3): 453-470.
28 The Connect America Fund Phase II (Auction 903) was conducted in 2018, in which "103 bidders won $1.49 billion over 10 years to provide fixed broadband and voice services to over 700,000 locations in 45 states," see https://www.fcc.gov/auction/903. The Rural Digital Opportunity Fund (RDOF) (Auction 904) is a two-part auction with "$20.4 billion to be awarded over 10 years, with $16 billion will be made available for Phase I… and the remaining Phase I budget, along with $4.4 billion, will be awarded for Phase II of the auction," see https://www.fcc.gov/auction/904.
29 NTIA notes that not all executive summaries were available for applicants. "Please note that executive summaries are not posted for all applications. Applicants were given the choice of publishing their full executive summary, a redacted summary, or no executive summary at all. The executive summaries provided in this database are from those applicants that provided express written permission to publish their summaries." See https://www.ntia.doc.gov/legacy/broadbandgrants/applications/search.cfm. Many executive summaries did not include fiber miles or budget data.

I estimated unit costs from the proposals, collecting the applicants' narrative descriptions, their proposed total budgets, proposed numbers of community anchor institutions (buildings), and proposed numbers of fiber miles to be installed.[30] I calculated an estimated cost-per-building by dividing each project's proposed budget by the total number of proposed connected buildings. This simple calculation meant that I included overhead costs in the unit costs when I divided proposed award budgets by outputs delivered. I assumed that all projects had the same percentage of overhead costs and that there were no scale effects in budget size to output.

Of the 773 available application summaries, not all summaries included the data needed in my study. Ultimately, my dataset included 403 applications that provided the number of buildings with new broadband connections and 231 applications that provided the number of fiber miles that applicants proposed to install. Due to limited data, I focused my counterfactual analysis on the number of proposed connected buildings in the application files, rather than fiber miles. I attempted to run the analysis on the fiber miles data, but I found that the dataset was too small to adequately compare alternative allocation methods with and without the one-project-per-state rule.

There may be an adverse selection issue in this missing data, where lower quality applicants may have submitted poorly prepared applications, omitting critical data on proposed outputs. If the missing data represents lower quality projects, then my results will be biased. It is unclear whether the bias is upward or downward, however. If these lower quality projects would have fallen below a minimum eligibility threshold, then they may have been dropped from contention in an auction, indicating no bias in my results. If the missing projects were included, perhaps the additional competition would result in lower prices, indicating an upward bias in my results. The missing projects may also have won some of the subsidies with lower quality and higher prices, indicating a downward bias in my results. On net, I assume that the missing data does not undermine my general findings.

With the public data I was able to collect, I simulated a reverse auction by sorting projects from low to high-price bids using my unit cost calculations and by selecting the second-lowest bids. In a second-price reverse auction, the lowest bidder honors the second-lowest bid price, in order to incentivize bidders to bid according to their true valuations. In my counterfactual analysis, I ran the reverse auction with the one-project-per-state rule and without the one-project-per-state rule by pooling all the applications together across states. I assumed that the winners of the reverse auctions were selected based only on the bid price with a budget constraint of $3.4 billion, and that the quality of the projects were the same with minimum eligibility standards.

30 Total fiber miles can be used to generally describe the scope of a broadband project, but does not convey quality. Quality of fiber-optic cabling varies considerably, depending on the total strand count of fiber-optic lines. Total strand count depends on whether the fiber links are lateral or backbone connections in aerial or buried locations. However, total fiber miles is often the topline metric used to describe broadband infrastructure projects.

To be sure, an actual reverse auction should usually be based on more than just a normalized bid, as bidders could easily game such a simple methodology. Unqualified bidders might submit low-ball bids that they are unlikely to complete. Low-cost bidders may propose projects in areas with existing infrastructure where additional broadband is inexpensive to install. High-cost bidders might need public subsidies to reach unserved, remote locations which are expensive to connect on a unit cost basis. For those reasons, a real-world reverse auction must carefully select geographic areas eligible for inclusion and include multiple criteria to score bids. The FCC has taken this approach in the CAF Phase II and RDOF auctions.[31]

Nevertheless, my simplified approach is instructive because a back-of-the-envelope comparison allows policymakers to consider the range of outcomes possible between alternative allocation methods. Even with a limited number of parameters such as budget constraint, unit cost, and allocation method, this approach offers a baseline comparison which can be extended with further data or complexity if needed.

For the lottery, I ran a Monte Carlo simulation with several rounds, which models the randomness inherent in such an allocation method. Rather than predicting results from one lottery, I ran multiple lotteries and averaged the results. Even though a lottery run by the government would be run only once, the randomness in that one draw should be modeled across multiple simulated rounds. In each draw, my algorithm identified a set of randomly selected projects that could be subsidized with a budget of $3.4 billion. A random number generator was used to identify projects from the applicant pool. I averaged the results from the separate rounds into one average index.

C. Results

I found that a reverse auction may have yielded nearly twice as many buildings with new broadband connections compared to the grant review process for the same total budget of subsidies (Table 1). Even a reverse auction that included the one-project-per-state minimum constraint would have yielded 50,000 more connected buildings than the grant review process, at about $3,000 less in subsidy spending per building. The table also shows a much larger variance in number of buildings connected in the grant review process than in auctions or a lottery.

31 Many grant proposals in the applicant pool may not have met a minimum eligibility threshold of building in unserved locations with reasonable, qualified bids. If so, then further research may be warranted on the supply of shovel-ready projects for publicly-funded broadband stimulus programs outside of the compliance requirements in the Universal Service Fund program. In fact, NTIA extended the deadline for applications for infrastructure grants which industry analysts attributed to a lack of quality applications. "Second (and Last) NTIA/RUS NOFA Released," https://www.commlawblog.com/2010/01/ articles/cellular/second-and-last-ntiarus-nofa-released/; NTIA, Second Notice of Funds Availability (NOFA), https://www.ntia.doc.gov/files/ntia/ publications/fr_btopnofa_100115_0.pdf (January 22, 2010). The economists who recommended auctions anticipated concern over a minimum eligibility threshold. Concerned Economists, at 7 ("In order to avoid an extended post-bidding process of weeding out and correcting frivolous bidding and overbidding, a procurement auction process must include a pre-bid indication of intent from prospective bidders and a simple prescreening process. Prescreening could be as simple as a statement committing to meet all requirements of ARRA and the procurement auction rules…").

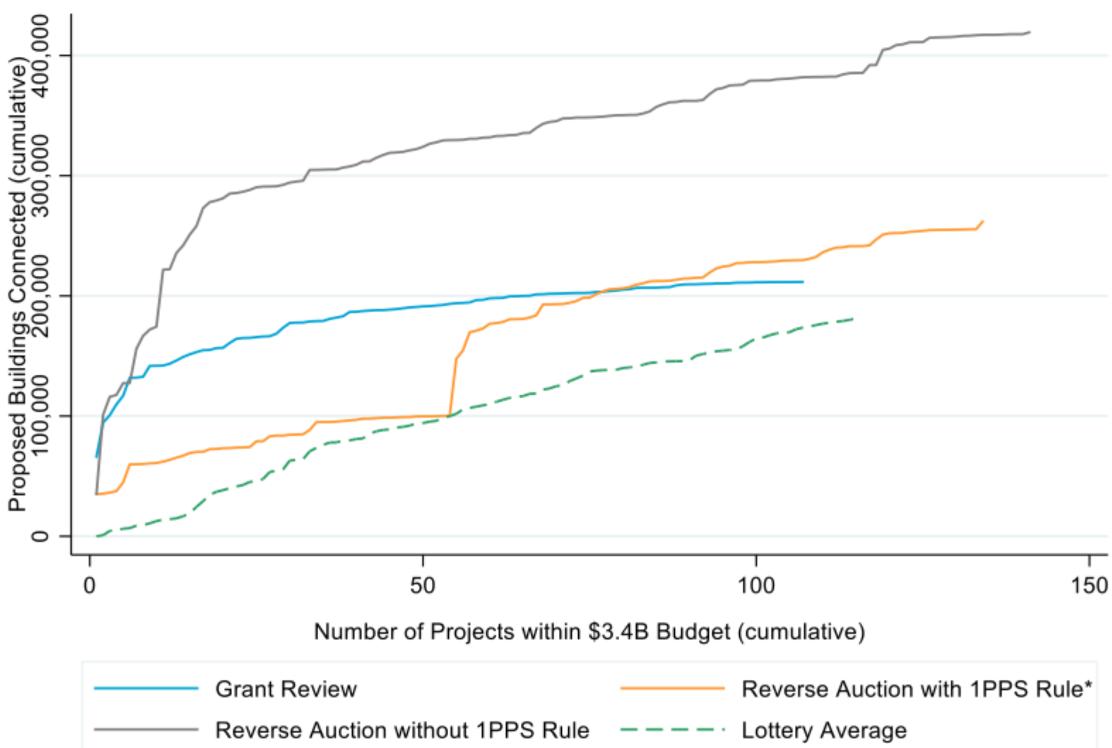
Table 1. Counterfactual Results from Grant Review, Reverse Auction, and Lottery

Allocation Method	Number of Winning Projects	Proposed Number of Buildings Connected in Winning Projects	Average Proposed Subsidy-Per-Building in Winning Projects	Mean of Project-Level Subsidy-Per Building Means
Grant Review	107	211,617	$16,067	$105,157*
Reverse Auction	134	261,943	$12,980	$27,903
*Reverse Auction***	141	419,315	$8,108	$19,719
*Lottery***	116	182,282	$18,652	$24,267

* A few outlier projects explain this discrepancy in costs. See discussion in text.

** Without the one-project-per-state (1PPS) statutory requirement.

Figure 2. Number of Proposed Projects by Alternative Allocation Method



*Note: An uptick occurs after the one-project-per-state (1PPS) rule is satisfied

Figure 3. Number of Buildings Connected by Alternative Allocation Method for 3.4 Billion

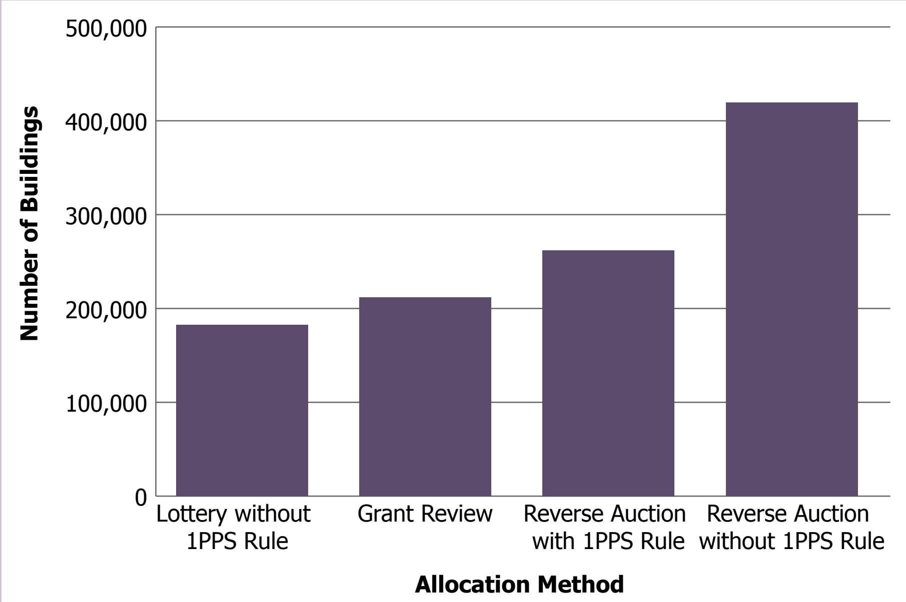


Figure 2 shows the cumulative number of buildings that could have been connected with broadband subsidies across alternative allocation methods. The figure shows a horse race between grant review, a reverse auction with the one-project-per-state rule, a reverse auction without the one-project-per-state rule, and results from a lottery from a Monte Carlo simulation.

Grant review resulted in 211,617 proposed connected buildings across 107 projects for an estimated subsidy cost-per-building of $16,067, and a project building average of $105,157.[32] A few outlier projects and a limitation in my methodology explains the large mean of means in the grant review process. Several projects listed proposed costs of over $800,000 to connect each community anchor institution in their middle-mile networks. Also, because I estimated simple unit costs of subsidy budget divided by number of connected buildings, I did not weigh unit costs according to how many fiber miles were also simultaneously deployed in each project. Each project proposed to install fiber miles along with buildings, with varying weights between the fiber miles and number of buildings. I assumed the proportion of connected buildings to fiber miles deployed in each project were equal, but that is not the case.[33] The proportion of buildings to fiber miles can be incorporated in econometric controls, as seen in other empirical work.

32 Ten of the 123 projects were terminated early, leaving 113 projects. Proposal documents had missing data, limiting the observations in my dataset. I conducted this analysis on projects with data (N=403). I assume that missing data is randomly distributed.
33 In a more detailed empirical analysis, see Oh, Sarah. 2016. "How Predictive are Cost Forecasts for Broadband Stimulus? Evidence from the Recovery Act," GMU Working Paper in Economics, https://ssrn.com/abstract=2963377. In that paper, I run regressions to control for the variation across projects along all dimensions of network specification, including strand count, aerial or buried lines, and lateral or backbone connections. For the purposes of this back-of-the-envelope analysis, I assume that the distribution of fiber miles to buildings connected does not affect my estimate of simple averages.

These proposals also included a mix of fiber and wireless connections. For purposes of this study, I assumed that the mix of proposals did not bias the results in the grant review, reverse auction, or lottery. I did not control for technology type in this study, but further econometric analysis could include such controls.[34] The mix of technologies in the projects awarded by grant review is shown in Table A1 of the Data Appendix.[35] I ran robustness checks in the counterfactual results to test the mix of wireless and fiber projects in the results. I found that the one-project-per-state rule preserved a mix of technology types because each of the states had a different composition of applicants. Some states had more wireless applicants and other states had fiber-only projects.

It's important to note that the mix of fiber only, wireless only, and fiber and wireless projects affects how proposals can compete on unit costs.[36] Each type of technology has different cost structures with lower costs seen in wireless only networks and higher costs in fiber only networks, and a range of high and low costs in hybrid fiber-wireless infrastructure. A reverse auction that selects projects based on lower unit costs will likely identify winners who offer to supply lower-cost technologies such as wireless and hybrid wireless-fiber configurations more frequently than more costly fiber-only networks. In this study, I observed that the one-project-per-state rule lead to the government's selection of a mix of technology types in the awarded projects, even though the rule was not explicitly designed for that purpose.[37]

A reverse auction with the one-project-per-state rule may have resulted in more broadband than grant review did. In a reverse auction that awarded the second lowest-cost bid in each state, as many as 50,000 more buildings might have been connected with an estimate of 261,943 newly connected buildings. These winning bids had an average proposed cost-per-building of $12,980 and project building average of $27,903, amounting to a considerable discount on price compared to projects selected by grant review.

Reverse auctions without the one-project-per-state requirement, which resulted in higher cost projects being selected over lower cost projects, would have connected even more buildings. By pooling all the applications into one auction, even more of the cost effective bids would have won subsidies. Some states may not have received subsidies, but more broadband could have been deployed at lower cost in other states. My analysis shows that 419,315 buildings could have been connected with an estimated proposed subsidy cost-per-building of $8,108 and project building average of $19,719.

34 Id.
35 Supra note 33. In an extensive empirical analysis, Oh (2016), I control for differences in fiber only, wireless only, and fiber and wireless connections in estimating unit costs across projects.
36 The proposed subsidy cost-per-building estimates in Table 1 are lower than industry estimates, likely because projects included hybrid deployments that included wireless connections for middle-mile infrastructure.
37 The statute does not explain Congress's purpose in the one-project-per-state rule.

Put another way, the cost of the one-project-per-state minimum – even when using the more efficient reverse auction as compared to the grant process – was about 157,000 buildings not connected that could have been. The reason this requirement has such a high cost is the low level of competition among grant proposals in some states. Two states – North Dakota and New Hampshire – received only two applications, meaning a 50 percent acceptance rate of applications in those states. Several other states also had very high acceptance rates. Idaho, North Carolina, Vermont, and Wyoming each had acceptance rates over 40 percent.[38] Contrast these states with California or New York with 2 percent and 6 percent acceptance rates. Table A2 in the Data Appendix shows the acceptance rates by state with the number of awarded projects and total number of applications submitted. Without this one-project-per-state requirement, the bids in California and New York would have competed on price with the bids in North Dakota, New Hampshire, or Idaho.

The grant review process performed only somewhat better than a lottery would have, connecting 30,000 more buildings than a random selection of projects. The simulation suggests that a lottery could have connected 182,282 with an average cost-per-building of $18,652, compared to 211,617 buildings at average cost-per-building of $16,067 for the grant review process.

D. Discussion

Although the government did not run a reverse auction to allocate BTOP subsidies in 2009,[39] I simulated alternative outcomes if it had tried to do so based on proposed costs observed in the application files. My empirical investigation shows that a reverse auction might have yielded double the output with the same subsidy budget. If the most important objective of broadband stimulus is to buy as much broadband as possible in unserved areas around the country, then a reverse auction is likely to have fulfilled that goal better than grant review. Relying on eligibility requirements that have been refined by the FCC over the last decade through the CAF II and RDOF auctions, Congress could have obtained more output with its appropriations in the Recovery Act.

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38 The one-project-per-state rule in broadband stimulus, and others like it in other infrastructure programs of the Recovery Act, may have been included to provide for equitable distribution of funds across the states. Gimpel, Lee, and Thorpe (2013) found that Recovery Act funds at the county-level were skewed. Counties received 5.3 times more in the 90th percentile of infrastructure funding than the median county. (Id. at 578). Low-income counties did not receive infrastructure, but rather, "medium income takes a positive, statistically significant coefficient in the model for infrastructure spending." (Id. at 580). In other words, richer counties received more infrastructure spending than poorer counties in the Recovery Act. With proper econometric controls, they found "unemployment had no statistically significant effect on program allocations." (Id.).

39 A natural experiment could have been conducted by the NTIA by distributing stimulus funds differently across six regions in the United States by "Regional Economic Area Grouping" (REAG) each containing rural and urban areas with approximately 50 million people each. Concerned Economists, at 9-10.

Congress can do better by directing NTIA to use reverse auctions. Unfortunately, just last month, Congress directed NTIA to use a ranked list of priorities to distribute $300 million in a new broadband infrastructure program, repeating similar features of the qualitative scoring method as they implemented in the BTOP program of 2009.[40] In the December 2020 omnibus spending law, $1 billion was appropriated for tribal broadband grants[41] and $300 million in broadband infrastructure funds.[42]

Fortunately, the $300 million program does not include a one-project-per-state requirement. Yet other features of the new grant program will impose constraints on how competitive the results can be. Cost effectiveness is listed as a third most important priority for allocation of funds, combined with an equally important priority to deploy broadband to rural areas.[43] These two priorities may not be easily squared, since tradeoffs between cost effectiveness, broadband speeds, and unserved and underserved populations are not straightforward in universal broadband policy. Evidence from the BTOP program shows that constraints on grant programs such as a one-project-per-state rule can limit the cost effectiveness of stimulus funds.

Congress could do better to improve on subsidy distribution with lessons learned from BTOP. A reverse auction that prioritizes cost effectiveness could yield better results than lists of priorities and quantitative criteria.

40 Consolidated Appropriations Act of 2021, signed into law Dec. 27, 2020; Rules Committee Print 116-68, Text of the House Amendment to the Senate Amendment to H.R. 133, Dec. 21, 2020, 9:35 a.m. ("(4) Priority.—In awarding grants under this subsection, the Assistant Secretary shall give priority to applications for covered broadband projects as follows, in decreasing order of priority: (A) Covered broadband projects designed to provide broadband service to the greatest number of households in an eligible service area. (B) Covered broadband projects designed to provide broadband service in an eligible service area that is wholly within any area other than— (i) a county, city, or town that has a population of more than 50,000 inhabitants; and (ii) the urbanized area contiguous and adjacent to a city or town described in clause (i). (C) Covered broadband projects that are the most cost-effective, prioritizing such projects in areas that are the most rural. (D) Covered broadband projects designed to provide broadband service with a download speed of not less than 100 megabits per second and an upload speed of not less than 20 megabits per second. (E) Any other covered broadband project that meets the requirements of this subsection.").

41 Id. ("(2) Grants.—From the amounts appropriated under subsection (b)(1), the Assistant Secretary shall award a grant to each eligible entity that submits an application that the Assistant Secretary approves after consultation with the Commission to prevent duplication of funding. (3) Allocations.— (A) Equitable Distribution.—The amounts appropriated under subsection (b)(1) shall be made available to eligible entities on an equitable basis, and not less than 3 percent of those amounts shall be made available for the benefit of Native Hawaiians.").

42 Id. ("(d) Broadband Infrastructure Program.— (1) Broadband Infrastructure Deployment Grants.—The Assistant Secretary shall use the funds made available under subsection (b)(2) to implement a program under which the Assistant Secretary makes grants on a competitive basis to covered partnerships for covered broadband projects… (3) Eligibility Requirements.—To be eligible for a grant under this subsection, a covered partnership shall submit an application at such time, in such manner, and containing such information as the Assistant Secretary may require, which application shall, at a minimum, include a description of— (A) the covered partnership; (B) the covered broadband project to be funded by the grant, including— (i) the speed or speeds at which the covered partnership plans to offer broadband service; and (ii) the cost of the project; (C) the area to be served by the covered broadband project (in this paragraph referred to as the "proposed service area"); (D) any support provided to the provider of broadband service that is part of the covered partnership…").

43 Id. ("Covered broadband projects that are the most cost-effective, prioritizing such projects in areas that are the most rural.") (emphasis added).

Conclusion

A reverse auction might have resulted in nearly twice as many connected buildings than the grant selection process in the BTOP program of 2009. If low-cost bids were selected over high-cost bids in a reverse auction, as 71 economists recommended, thousands of additional buildings might have been connected with broadband and thousands of additional miles of fiber installed with $3.4 billion in Recovery Act funds.

The government missed an opportunity to deploy more broadband at lower prices. If it had chosen to use market-based methods of distribution rather than grant review, it could have extended and stretched the dollars into more connectivity to unserved and underserved areas of America. Administrators of hew broadband subsidy programs should learn from this experience and use modern reverse auctions to distribute funds. While it may be too late in the Consolidated Appropriations Act of 2021, Congress would do well to direct federal agencies to use modern reverse auction mechanisms to increase output from subsidy dollars.

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Data Appendix

Table A1. Middle-Mile BTOP Projects in the Recovery Act

No.	Broadband Project	Entity Type	Network	State
1	Los Angeles Regional Interoperable Communications System Authority The Los Angeles Public Safety Broadband Network: LA-SafetyNet	Local Gov	Wireless	CA
2	Executive Office State Of West Virginia West Virginia Statewide Broadband Infrastructure Project-"Middle Mile"	State Gov	Fiber & Wireless	WV
3	Information Technology, Maryland Department Of One Maryland Broadband Network	State Gov	Fiber	MD
4	Centennial Board Of Cooperative Educational Services Colorado Comm Anchors Broadband Consortium Connecting CO's Middle Mile	State Gov	Fiber & Wireless	CO
5	Keystone Initiative For Network Based Education and Research Pennsylvania Research and Education Network (PennREN)	For-Profit	Fiber	PA
6	University Of Arkansas System Arkansas Healthcare, Higher Ed, Pub Saf, Research Integr Broadband Initiative	Higher Ed	Fiber	AR
7	Information Technology, Dept. Of Access Connecticut: Expanding the State's Education and Public Safety Network	State Gov	Fiber	CT
8	Northwest Open Access Network NoaNet BB Infrastructure Project	For-Profit	Fiber & Wireless	WA
9	MCNC North Carolina Rural Broadband Initiative	For-Profit	Fiber	NC
10	California Broadband Cooperative, Inc. Digital 395 Middle Mile	For-Profit	Fiber	CA
11	University Corporation For Advanced Internet Development United States Unified Community Anchor Network (U.S. UCAN)	For-Profit	Fiber	MI
12	Central Management Services, Illinois Department Of Illinois Broadband Opportunity Partnership East Central Region	State Gov	Fiber & Wireless	IL
13	State Of Louisiana Board Of Regents Louisiana Broadband Alliance - Infrastructure Project	State Gov	Fiber	LA
14	Horizon Telcom, Inc. Connecting Appalachian Ohio Middle Mile Consortium	Non-Profit	Fiber	OH
15	Finance, Oklahoma Office Of State Oklahoma Community Anchor Network (OCAN)	State Gov	Fiber	OK
16	Merit Network Inc. REACH Michigan Middle Mile Collaborative II	For-Profit	Fiber	MI
17	Trillion Communications Corp. South Central Alabama Broadband Commission (SCABC - CCI)	Non-Profit	Fiber	AL
18	Executive Office Of The State Of Mississippi Mississippi Education, Safety and Health Network	State Gov	Fiber & Wireless	MS
19	Northwest Open Access Network State of Washington Broadband Consortium	For-Profit	Fiber	WA
20	Virgin Islands Public Finance Authority viNGN Comprehensive Community Infrastructure Program	State Gov	Fiber	VI
21	Motorola, Inc. San Francisco Bay Area Wireless Enhanced Broadband Project (BayWEB)	Non-Profit	Wireless	CA
22	Massachusetts Technology Park The Massachusetts Broadband Institute MassBroadband 123	State Gov	Fiber	MA
23	CVIN, LLC The Central Valley Next Generation Broadband Infrastructure Project	Non-Profit	Fiber	CA
24	Northern Illinois University Inc. Illinois Broadband Opportunity Partnership Northwest Region	Higher Ed	Fiber & Wireless	IL
25	Bluebird Media, L.L.C. Northern Missouri Ultra-High Capacity Middle Mile	Non-Profit	Fiber	MO
26	University System Of New Hampshire Network New Hampshire Now	For-Profit	Fiber & Wireless	NH
27	OneCommunity Transforming NE Ohio: From Rust Belt to Tech Powerhouse, An Ohio Middle Mile Consortium Project	For-Profit	Fiber	OH
28	Department Of Information Technology New Mexico Statewide Interop Radio Comm Internet Transp Sys (SIRCITS)	State Gov	Wireless	NM
29	Govnet LLC SACCNet - Arizona Critical Middle Mile	Non-Profit	Fiber & Wireless	AZ
30	Treasury, New Jersey Department Of The State of New Jersey Broadband Network	State Gov	Fiber	NJ
31	ION Hold Co., LLC ION Upstate New York Rural Broadband Initiative	Non-Profit	Fiber	NY
32	Vermont Telecommunications Authority Vermont Fiber Link	State Gov	Fiber	VT
33	Navajo Tribal Utility Authority Navajo Nation Middle/Last Mile Proj: Quality Broadband for the Navajo People	Tribe	Fiber & Wireless	AZ

34	Delta Communications, L.L.C. Illinois Broadband Opportunities Partnership - Southern	Non-Profit	Fiber	IL
35	Com Net, Inc. GigEPAC--GigE PLUS Availability Coalition	Non-Profit	Fiber	OH
36	University Of Wisconsin System Building Community Capacity through Broadband	Higher Ed	Fiber & Wireless	WI
37	University Of Hawaii Systems Ke Ala--Ike: Connecting Hawaii's Comm Colleges, Univ, Schools and Libraries	Higher Ed	Fiber	HI
38	North Georgia Network Cooperative Inc. North Georgia Network	For-Profit	Fiber	GA
39	Merit Network Inc. REACH Michigan Middle Mile Collaborative	For-Profit	Fiber	MI
40	OpenCape Corporation OpenCape Corporation Middle Mile Project	For-Profit	Fiber & Wireless	MA
41	North Florida Broadband Authority Ubiquitous Middle Mile	Local Gov	Wireless	FL
42	MCNC Building a Sustainable Middle-Mile Network for Underserved Rural NC	For-Profit	Fiber	NC
43	Sho-Me Technologies L.L.C. MoBroadbandNow 'Sho-Me MO' Middle Mile Project	For-Profit	Fiber	MO
44	Bristol Virginia Utilities Board Southwest Virginia Middle Mile Project	Local Gov	Fiber	VA
45	Peoples Telephone Cooperative Inc. East Texas Medical and Educational Fiber Optic Network	For-Profit	Fiber	TX
46	Executive Office Of Commonwealth Of Pennsylvania Office Of Administration Cmwth of PA Broadband Middle Mile Proj: Enhancing Connectivity in N. PA	State Gov	Wireless	PA
47	Florida Rural Broadband Alliance Florida Rural Middle Mile Networks - Northwest and South Central Regions	For-Profit	Fiber & Wireless	FL
48	Critical Hub Networks, Inc. Puerto Rico Bridge Initiative	Non-Profit	Fiber & Wireless	PR
49	Ocean State Higher Ed Economic Development Administrative Network Beacon 2.0	For-Profit	Fiber	RI
50	Biddeford Internet Corp. (D.B.A. GWI) Three Ring Binder	Non-Profit	Fiber	ME
51	Troy Cablevision, Inc. Southeast AL SmartBand Rural Broadband for Econ Dev and Energy Mgmt	Non-Profit	Fiber	AL
52	Board Of Trustees Of The University Of Illinois Urbana-Champaign Big Broadband Below Ground UC2B Middle Mile, Last Mile	Higher Ed	Fiber	IL
53	State Of Wisconsin Department Of Administration Wisconsin's Education and Library Broadband Infrastructure Build-out	State Gov	Fiber	WI
54	Zayo Bandwidth, LLC Indiana Middle Mile fiber for Schools, Communities and Anchor Institutions	Non-Profit	Fiber	IN
55	Appalachian Valley Fiber Network Appalachian Valley Fiber Network ("AVFN")	Non-Profit	Fiber	AL
56	Contact Network, Inc. South Central Mississippi Broadband Infrastructure Project	Non-Profit	Fiber	MS
57	South Dakota Network, LLC Project Connect South Dakota Delivering 10 MB for Community Anchor Inst	Non-Profit	Fiber	SD
58	District Of Columbia Government "DC-CAN" - DC Community Access Network	State Gov	Fiber & Wireless	DC
59	Nevada Hospital Association Nevada Broadband Telemedicine Initiative	For-Profit	Fiber	NV
60	Iowa Health System Iowa Healthcare Plus Broadband Extension Project	For-Profit	Fiber	IA
61	UTOPIA Utah Telecomm Open Infrastructure Agency Community Partnership Project	State Gov	Fiber	UT
62	Enventis Telecom, Inc. Greater Minnesota Broadband Collaborative	Non-Profit	Fiber	MN
63	Iowa Communications Network Bridging the Digital Divide for Iowa's Communities	State Gov	Fiber	IA
64	E.N.M.R. Telephone Cooperative Extending the Middle Mile: ENMR-Plateau Middle Mile CCI Project	For-Profit	Fiber	NM
65	Valley Telephone Cooperative Inc. Rio Grande Valley Fiber Network	Non-Profit	Fiber	TX
66	Charlotte, City Of CharMeck Connect	Local Gov	Wireless	NC
67	Mid-Atlantic Broadband Cooperative Middle Mile Expansion for Southern Virginia	For-Profit	Fiber	VA

68	Ronan Telephone Co. Montana West	Non-Profit	Fiber & Wireless	MT
69	Education Networks Of America, Inc. Broadband Access and Equity for Indiana Community Anchor Institutions	Non-Profit	Fiber	IN
70	Zayo Bandwidth, LLC Connect Anoka County Community Broadband Network	Non-Profit	Fiber	MN
71	Columbia County Georgia IT Columbia County Community Broadband Network (CCCBN)	Local Gov	Fiber & Wireless	GA
72	University Of Utah Utah Anchors: A Community Broadband Project	Higher Ed	Fiber	UT
73	Region 18 Education Svc Ctr Connect Southwest Texas	State Gov	Fiber & Wireless	TX
74	Plumas Sierra Rural Electric Cooperative Plumas-Sierra Telecommunications (PST) Middle Mile Fiber Project	Non-Profit	Fiber	CA
75	Adams County Communications Center, Inc. ADCOM 911/DIA Regional Broadband Public Safety Network	For-Profit	Fiber & Wireless	CO
76	ENMR Telephone Cooperative, Inc. Dba ENMR-Plateau ENMR-Plateau Middle Mile	For-Profit	Fiber	NM
77	NebraskaLink, LLC Connecting Nebraska Communities A High-Speed Broadband Network for All of Nebraska	Non-Profit	Fiber	NE
78	Iniciativa Tecnológica Centro Oriental, Inc. (Inteco, Inc.) Construction of Broadband Infrastructure Central East Region of Puerto Rico	For-Profit	Fiber & Wireless	PR
79	DCN, LLC DCN's CCI Broadband Project	Non-Profit	Fiber	ND
80	DeKalb County Government DeKalb Advancement of Technology Authority Broadband	Local Gov	Fiber	IL
81	Contact Network, Inc. Mississippi Delta Broadband Infrastructure Project	Non-Profit	Fiber	MS
82	Oconee, County Of Oconee FOCUS (Fiber Optics Creating Unified Solutions)	Local Gov	Fiber	SC
83	North Central New Mexico Economic Development District REDI Net	State Gov	Fiber	NM
84	Vermont Telephone Company, Inc. Vermont Broadband Enhanced Learning Link (VT BELL)	Non-Profit	Fiber	VT
85	Mid-Atlantic Broadband Cooperative Middle Mile Expansion for Eastern Virginia	For-Profit	Fiber	VA
86	Nexus Systems, Inc. Louisiana 'Piney Hills' Parishes Broadband Infrastructure Project	Non-Profit	Fiber	LA
87	Deltacom, Inc. East Tennessee Middle Mile Fiber Broadband Project	Non-Profit	Fiber	TN
88	Citizens' Telephone Co-Operative NRV-ROAN (New River Valley Regional Open Access Network)	For-Profit	Fiber	VA
89	Clackamas, County Of Clackamas Broadband Innovation Initiative	Local Gov	Fiber	OR
90	Lane Council Of Governments Oregon South Central Regional Fiber Consortium Lighting the Fiber	Local Gov	Fiber	OR
91	IT&E Next Generation Network - Middle Mile Infrastructure Plan	Non-Profit	Wireless	GU
92	Rockbridge, County Of Connecting the Dots: Rockbridge Broadband Initiative	Local Gov	Fiber	VA
93	Texas A & M University Texas Pipes	Higher Ed	Fiber	TX
94	Pyramid Lake Paiute Tribe Pyramid Lake Paiute: Natukwena Nagwesenoo	Tribe	Fiber	NV
95	Board Of Regents Of University Of Wisconsin System Metropolitan Unified Fiber Network (MUFN)	Higher Ed	Fiber	WI
96	JKM Consulting, Inc. Project BEAR (Broadband for East Alabama Region)	Non-Profit	Fiber	AL
97	Zito Media Communications II, LLC Northeastern Ohio and Northwestern Pennsylvania Fiber Ring Project	Non-Profit	Fiber	PA
98	Carver, County Of Carver County Open Fiber Initiative (CCOFI)	Local Gov	Fiber	MN
99	Silver Star Telephone Company, Inc. Expanding Greater Yellowstone Area Broadband Opportunities	Non-Profit	Fiber	WY
100	Bloomingdale Communications Inc. Van Buren County Fiber Ring	Non-Profit	Fiber	MI
101	Virginia Tech Foundation, Inc. Allegheny Fiber: Extending VA's Open Access Fiber Backbone to Ridge & Valley	For-Profit	Fiber	VA

102	Onwav Inc. Five County Broadband Interconnected Training Access	Non-Profit	Wireless	TN
103	Silver Star Telephone Company, Inc. Delivering Opportunities: Investing in Rural Wyoming Broadband	Non-Profit	Fiber	WY
104	Bend Cable Communications, LLC Central Oregon Fiber Alliance	Non-Profit	Fiber	OR
105	Level 3 Eon, LLC Expanding broadband access across Texas	Non-Profit	Fiber	TX
106	Hardy Telecommunications, Inc. Hardy AnchorRing	For-Profit	Fiber	WV
107	Level 3 Eon, LLC Expanding Broadband Access Across California	Non-Profit	Fiber	CA
108	First Step Internet, LLC Central North Idaho Regional Broadband Network Expansion	Non-Profit	Fiber & Wireless	ID
109	Level 3 Eon, LLC Expanding Broadband Access Across Florida	Non-Profit	Fiber	FL
110	Nelson County Virginia Nelson County Virginia Broadband Project	Local Gov	Fiber & Wireless	VA
111	Nez Perce Tribe Nez Perce Reservation Broadband Enhancement	Tribe	Wireless	ID
112	Page County Broadband Authority Page BBA Broadband Project	Local Gov	Fiber	VA
113	Ute Indian Tribe Uintah and Ouray Reservation Fiber Optic Infrastructure Project	Tribe	Fiber & Wireless	UT
114	Level 3 Eon, LLC Expanding Broadband Access Across Georgia	Non-Profit	Fiber	GA
115	Level 3 Eon, LLC Expanding Broadband Access Across Tennessee	Non-Profit	Fiber	TN
116	Level 3 Eon, LLC Expanding Broadband Access Across Kansas	Non-Profit	Fiber	KS

Table A2. Acceptance Rates by State for BTOP Middle-Mile Applications

Accept Rate	State	Number of Winning Bids	Number of Rejected Bids	Average Awarded Budget	Average Rejected Budget	Max Awarded Budget	Max Rejected Budget
60%	ID	3	2	$28,100,000	$5,179,223	$79,000,000	$8,143,731
50%	NC	3	3	$58,200,000	$22,500,000	$112,000,000	$38,800,000
50%	ND	1	1	$15,400,000	$5,055,125	$15,400,000	$5,055,125
50%	NH	1	1	$65,900,000	$484,145	$65,900,000	$484,145
50%	VT	2	2	$33,900,000	$19,300,000	$48,200,000	$32,000,000
40%	WY	2	3	$6,790,796	$4,459,707	$7,235,020	$7,546,066
38%	CO	10	16	$23,400,000	$95,900,000	$144,000,000	$348,000,000
33%	MT	1	2	$18,200,000	$25,800,000	$18,200,000	$51,300,000
33%	SD	1	2	$25,700,000	$104,000,000	$25,700,000	$132,000,000
33%	UT	3	6	$15,300,000	$12,500,000	$24,100,000	$25,000,000
30%	OR	3	7	$9,316,619	$37,600,000	$11,100,000	$214,000,000
29%	TN	2	5	$12,400,000	$15,400,000	$18,400,000	$37,500,000
27%	NM	4	11	$28,500,000	$12,300,000	$55,700,000	$30,100,000
26%	AL	6	17	$31,500,000	$32,200,000	$87,000,000	$145,000,000
25%	GU	1	3	$10,100,000	$93,600,000	$10,100,000	$143,000,000
25%	ME	1	3	$31,800,000	$22,200,000	$31,800,000	$34,000,000
25%	MN	2	6	$15,800,000	$23,100,000	$24,000,000	$43,500,000
25%	VI	1	3	$90,600,000	$18,200,000	$90,600,000	$42,300,000
25%	WV	2	6	$65,200,000	$37,400,000	$126,000,000	$85,100,000
23%	VA	8	27	$13,000,000	$28,200,000	$37,300,000	$295,000,000
22%	MA	2	7	$56,100,000	$27,200,000	$71,600,000	$125,000,000
22%	NV	2	7	$20,300,000	$33,000,000	$29,600,000	$127,000,000
21%	WI	3	11	$27,100,000	$29,300,000	$42,700,000	$110,000,000
20%	LA	2	8	$61,700,000	$18,300,000	$111,000,000	$49,200,000
20%	NE	1	4	$16,500,000	$27,400,000	$16,500,000	$53,800,000
20%	OH	3	12	$69,300,000	$36,200,000	$95,000,000	$222,000,000
20%	RI	1	4	$33,600,000	$17,500,000	$33,600,000	$31,400,000
18%	AZ	2	9	$49,000,000	$40,200,000	$51,900,000	$143,000,000
18%	IL	6	28	$55,200,000	$38,700,000	$96,400,000	$129,000,000
17%	MS	1	5	$152,000,000	$31,200,000	$152,000,000	$98,900,000
17%	PR	2	10	$23,000,000	$17,500,000	$33,100,000	$63,700,000
17%	SC	1	5	$15,300,000	$31,900,000	$15,300,000	$67,500,000
15%	MO	2	11	$51,800,000	$66,100,000	$65,500,000	$197,000,000
14%	DC	1	6	$25,000,000	$70,400,000	$25,000,000	$174,000,000
13%	TX	4	27	$21,300,000	$29,400,000	$36,000,000	$202,000,000
13%	CT	1	7	$117,000,000	$26,900,000	$117,000,000	$110,000,000
13%	HI	1	7	$42,500,000	$136,000,000	$42,500,000	$294,000,000
13%	OK	1	7	$111,000,000	$23,700,000	$111,000,000	$65,400,000
11%	AR	1	8	$149,000,000	$16,200,000	$149,000,000	$62,900,000
11%	MD	1	8	$187,000,000	$65,100,000	$187,000,000	$126,000,000
11%	IA	2	17	$25,700,000	$14,600,000	$27,600,000	$154,000,000
10%	PA	3	27	$57,500,000	$12,800,000	$129,000,000	$49,800,000
9%	MI	4	42	$58,100,000	$4,834,113	$96,800,000	$75,200,000
8%	NJ	1	11	$175,000,000	$66,200,000	$175,000,000	$300,000,000
7%	FL	3	43	$32,000,000	$21,900,000	$34,100,000	$148,000,000
6%	WA	1	15	$103,000,000	$12,500,000	$103,000,000	$27,900,000
6%	GA	2	31	$29,900,000	$16,500,000	$41,900,000	$150,000,000
6%	CA	4	67	$108,000,000	$23,500,000	$245,000,000	$210,000,000
2%	NY	1	46	$49,700,000	$44,900,000	$49,700,000	$581,000,000
0%	AK		16		$104,000,000		$431,000,000
0%	AS		1		$2,686,308		$2,686,308
0%	DE		2		$5,863,253		$7,398,601
0%	IN		11		$8,778,922		$28,500,000
0%	KS		5		$18,100,000		$69,300,000
0%	KY		6		$31,200,000		$102,000,000
15%	**Total**	**116**	**657**	**$42,700,000**	**$31,600,000**	**$245,000,000**	**$581,000,000**

Table A3. Proposed and Actual Results from BTOP Middle-Mile Projects

No.	Project	Subsidy Budget	Proposed Fiber Miles	Actual Fiber Miles	Proposed Buildings	Actual Buildings
1	Los Angeles Public Safety*	$217,894,365	1769	0	204	0
2	State of West Virginia	$159,823,296	--	675	--	1127
3	State of Maryland	$158,416,520	--	1324	--	1068
4	Colorado Centennial	$135,300,777	4637	724	1106	126
5	Keystone PennREN	$128,958,031	--	1612	--	59
6	University of Arkansas	$128,581,820	--	49	--	458
7	State of Connecticut	$117,318,786	5544	1053	667	940
8	NoaNet WA	$106,546,591	--	780	--	152
9	MCNC North Carolina	$106,091,969	1448	1301	112	175
10	California Digital 395	$101,435,997	--	612	--	251
11	UCAN Michigan	$96,793,607	--	--	--	--
12	State of Illinois	$96,382,028	1026	1512	3138	3711
13	Louisiana Board of Regents*	$95,016,532	910	0	--	--
14	Ohio Horizon	$94,963,210	--	1318	--	467
15	State of Oklahoma	$92,907,816	1005	827	32	31
16	Merit REACH MI 1	$87,049,114	1210	1252	--	206
17	Trillion Alabama	$86,256,980	--	29	--	--
18	State of Mississippi*	$83,987,788	--	--	217	0
19	State of Washington	$75,307,089	496	471	283	151
20	Virgin Islands Public Auth.	$73,610,586	--	276	--	316
21	Motorola SF*	$72,483,637	--	--	--	--
22	Mass Tech Park	$71,645,444	1012	1180	1392	1233
23	Central Valley CA	$66,599,667	720	724	54	50
24	N. Illinois University	$66,173,301	--	639	--	487
25	Bluebird Northern Missouri	$64,803,350	981	833	--	102
26	University System of NH	$62,750,571	434	879	232	325
27	NE Ohio OneCommunity	$60,532,495	900	993	796	950
28	State of New Mexico	$55,700,000	--	--	151	23
29	Arizona GovNet	$51,561,929	--	--	266	123
30	State of New Jersey*	$49,547,690	739	0	149	0
31	Rural NY ION	$48,673,735	--	944	--	128
32	VT Telecom Auth.	$48,177,760	--	1000	342	316
33	Navajo AZ	$45,902,602	--	570	--	50
34	S. Illinois Delta Comm	$45,395,020	740	749	262	230
35	Ohio Com Net	$42,904,268	688	634	888	132
36	University of Wisconsin	$42,726,744	583	591	331	172
37	University of Hawaii	$42,466,000	235	409	388	384
38	North Georgia Network	$41,863,171	--	500	--	94
39	Merit REACH MI	$41,611,526	--	1044	--	146
40	OpenCape Mass	$40,161,393	--	306	--	91
41	Biddleford Maine	$39,369,676	--	--	--	100
42	MCNC Rural NC	$38,512,091	--	444	--	1866
43	Sho-Me Missouri	$38,000,000	500	540	100	101
44	Southwest VA Bristol	$36,220,536	388	370	0	0
45	East Texas Peoples Telco	$36,031,695	659	601	--	209
46	State of Pennsylvania	$35,980,017	--	--	--	47
47	Florida Rural	$34,149,665	--	--	196	3
48	Puerto Rico Critical Hub	$33,125,409	--	--	--	1
49	Rhode Island Beacon	$32,476,991	372	0	37	110
50	N. Florida Authority	$30,758,722	--	1149	--	100
51	Troy Cable Alabama	$30,688,821	595	529	147	198
52	University of Illinois	$29,280,837	--	224	28	256
53	State of Wisconsin*	$28,722,959	203	0	467	0
54	Indiana Zayo	$28,274,326	--	645	--	21
55	Appalachian Valley AL	$26,730,258	182	254	0	145
56	Mississippi South Contact	$25,906,278	2210	687	--	195
57	South Dakota Network	$25,715,303	--	397	--	512
58	Wash. DC-CAN	$25,033,000	--	211	291	291
59	Nevada Hospital	$24,971,267	--	389	37	3
60	Iowa Health System	$24,102,285	--	112	--	181
61	Utopia Utah	$24,071,690	251	142	395	158
62	Minnesota Enventis	$24,032,053	418	405	74	34
63	Iowa Communications	$23,867,544	12	26	476	2818
64	New Mexico ENMR	$23,515,451	189	282	287	369

65	Rio Grande TX	$22,425,509	166	200	139	24
66	Charlotte Charmeck NC*	$21,092,443	--	--	346	60
67	Southern Virginia Coop	$20,055,363	--	428	--	118
68	Montana Ronan	$19,738,925	257	299	17	33
69	Indiana ENA*	$18,351,465	--	--	--	--
70	Zayo Colorado	$18,278,375	286	215	151	131
71	Columbia County GA	$18,002,131	--	205	--	99
72	University of Utah	$17,495,691	--	58	--	142
73	Southwest TX Region 18	$17,279,343	194	244	46	63
74	Plumas Sierra CA	$17,212,800	--	189	--	17
75	Adams County CO	$16,678,760	23	9	13	20
76	ENMR New Mexico	$16,564,907	--	1887	--	269
77	Nebraska Link	$16,496,952	453	461	101	101
78	Puerto Rico INTECO	$16,343,675	--	--	--	84
79	Vermont Bell	$15,401,653	170	210	--	124
80	DeKalb County IL	$14,830,204	--	132	--	78
81	MS Delta Contact	$14,480,584	373	323	132	132
82	Oconee County SC	$14,306,764	245	252	157	102
83	New Mexico REDI	$13,391,443	148	108	123	110
84	North Dakota DCN	$12,861,126	--	256	--	124
85	Eastern VA	$12,529,059	170	174	25	19
86	Nexus Louisiana	$12,343,984	--	120	--	108
87	DeltaCom East TN	$11,731,815	--	44	--	2
88	New River Valley VA	$11,560,803	186	186	54	57
89	Clackamas County OR	$11,292,386	180	180	158	163
90	Lane Council OR	$10,439,035	--	104	--	139
91	Guam Next Gen	$10,062,992	--		--	420
92	County of Rockbridge VA	$9,995,752	134	70	53	52
93	Texas A&M University	$9,543,061	147	151	21	44
94	Pyramid Lake Tribe NV	$9,502,006	--	44	--	25
95	University of Wisconsin	$8,859,615	--	74	--	92
96	East Alabama JKM	$8,199,737	48	110	46	49
97	Zito OH and PA	$7,671,130	--	363	--	66
98	Carver County MN	$7,494,500	121	122	86	75
99	Silver Star Yellowstone WY	$7,234,820	89	82	16	41
100	Bloomingdale MI	$7,058,092	138	137	42	33
101	Virginia Tech	$6,925,000	--	106	--	2
102	Five County TN	$6,501,995	16	8	151	154
103	Silver Star Rural WY	$6,346,571	38	42	12	50
104	Oregon Bend Cable	$6,312,522	--	178	53	15
105	Level 3 TX*	$6,237,051	--	--	--	--
106	Hardy WV	$4,694,497	--	107	--	63
107	Level 3 CA*	$4,389,325	--	--	--	--
108	North Idaho First Step	$2,992,029	--	--	--	44
109	Level 3 FL*	$2,755,000	--	--	--	--
110	Nelson County VA	$2,283,308	--	31	--	13
111	Nez Perce Tribe ID	$2,282,589	56	0	18	18
112	Page County VA	$2,061,176	39	7	29	24
113	UTE Indian Tribe Utah	$2,051,021	5	9	34	43
114	Level 3 GA*	$1,903,080	--	--	--	--
115	Level 3 TN*	$1,727,650	--	--	--	--
116	Level 3 KS*	$1,331,225	--	--	--	--