BEAD Program: A Framework to Allocate Funding for Broadband Availability

National Overview

June 2023

ACA CONNECTS

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VERSION 3.0

A Letter from Grant Spellmeyer, President and CEO, ACA Connects

Dear State Broadband Leaders,

In September 2022, ACA Connects and Cartesian published the first version of the Broadband Equity, Access, and Deployment (BEAD) Program Framework. Our aim was to give you a jumpstart on preparing your Initial Proposals and Five-Year Action Plans by providing you with estimates about the funding you would receive and the potential ways it could be spent on broadband deployments — first using fiber, as the Notice of Funding Opportunity requires, and then with other broadband network technologies. In December 2022, we released an update of our analysis based on the first release by the Federal Communications Commission of the location-specific National Broadband Map, which greatly increased the accuracy of our estimates and analysis, even though the maps were still a work in progress. So far, we have been gratified by your reception for our work, and we have enjoyed the many follow-up discussions with State Broadband Offices across the U.S.

Today, we release version 3 of the BEAD Program Framework. It relies on the much more accurate National Broadband Map released in May 2023. It also incorporates additional locations where government agencies have committed funds for broadband deployments, as reflected in the FCC's Funding Map released earlier in May. Finally, it recognizes that, as States award funds for broadband deployment projects during 2024 and in later years, they will need to account for ongoing deployments funded though other programs or relying solely on private capital that bring service to locations previously classified as "unserved" or "underserved." As before, after you have reviewed our analysis, please let ACA Connects or its Members (who are identified in this presentation) know if you have any questions or require further information. We look forward to continuing our discussions with you.

Thank you.

Grant Spellmeyer

Source: Cartesian

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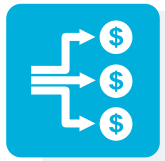
Overview | A Framework to Allocate and Award BEAD Funding for Broadband Availability

The goal of the BEAD Program is universal broadband availability

- To close the availability gap, BEAD Program provides States/Territories with $42B



States/Territories can gain insight today on available funds and expected deployment costs to prepare their Action Plans and funding proposals

- Using the FCC National Broadband Map, we can estimate the amount of funding each State/Territory will receive, the provider match, and the cost to deploy to eligible locations
- We estimate that when funds are allocated, approximately 12.0M locations in the U.S. will be unserved or underserved
- Through ongoing builds and removal of "committed" locations, the number of eligible locations decreases to 7.4M as of Jan. 2024. As explained in the Appendix, the number of locations actually eligible for BEAD funds will likely be considerably lower than 7.4M because there will be incremental builds between Jan. 2024 and when funds are awarded.
- For illustrative purposes, we estimate that fiber providers will be willing to match up to $3,000/location and that the overall provider match will add another $21B of funds – for a total of $64B in capital available for deployment projects

Our analysis indicates that funding is sufficient to achieve BEAD's broadband availability goal

- We find that $64B in funding should be sufficient to make broadband service available to all eligible locations
- Most all States/Territories should have sufficient funds to deploy fiber – the NOFO's preferred technology – to all unserved and underserved locations below a reasonable "extremely high-cost threshold" and use other technologies to serve the remaining "higher cost" locations, with the majority of States/Territories expected to have funds left over for affordability and other eligible programs
- States/Territories also may choose to achieve "maximum fiber" availability by using additional funds

Source: Cartesian

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Overview | What Precipitated Changes in V3 of Our BEAD Framework Analysis

The most recent FCC National Broadband Map has fewer eligible locations

- The December 2022 FCC National Broadband Map data contains ~12.0M unserved and underserved locations vs. 13.1M eligible locations in the data from June 2022
- Although the number of eligible locations has decreased, the number of unserved locations has increased (8.4M vs. 8.0M); we have updated the estimated BEAD funding allocation for individual states to align with the new data

The locations in the latest map are, on average, more costly to serve

- Updates to the FCC National Broadband Map have reduced the number of unserved and underserved locations at the lower end of the fiber cost curve, resulting in increase in the average cost to serve
- Compared against our V2 analysis, the average cost to serve an unserved location is ~$13.1k and an underserved location ~$10.8k (increases of roughly $3,000 and $2,500 respectively)

It is clear that most States/Territories will award funding later than the January 2024 date we used in the first versions of our analysis

- From discussions with States/Territories, we know BEAD program awards will start later than January 2024 and may be staged over several years; we model the impact of this timing through sensitivity analysis
- An additional 10% incremental build (*e.g.*, as a result of completed builds funded by government grants or private funds) increases fiber passing to 10.8M of the eligible 12.0M locations in our Maximum Fiber scenario

Source: Cartesian

BEAD Allocation and Fiber Deployment Analysis | Version 3.0 Methodology

Version 3.0 follows the same methodology as version 2.0, using updated data and adding a sensitivity analysis

	BEAD Funding Framework: V1.0 *Released September 28, 2022*	BEAD Funding Framework: V2.0 *Released February 2, 2023*	BEAD Funding Framework: V3.0 *Released June 21, 2023*
Serviceability Data Source	FCC Form 477 serviceability data (June 2021) overlaid with household and business premise estimates	FCC National Broadband Map data (June 2022 released in November 2022)	**FCC National Broadband Map data (December 2022 released in May 2023) and FCC Funding Map (May 2023)**
Partially Served Location Estimate	Applied state-specific partially served multiplier to estimate unserved locations	*Not Applicable*	
Proprietary Cost Model – Network Distances	Cartesian geospatial cost model using minimum spanning tree routing to optimally connect locations using 2010 CB boundaries	Updated cost model using 2020 CB boundaries	
Unit Cost Estimate	Modeled at household/business premise-level	Updated to be modeled at location-level with updated cost benchmarks to reflect market changes and inflation	
Eligible locations for BEAD Program awards	Estimated location count as of January 2024 accounting for ongoing commercial and subsidized build		**Sensitivity analysis added to model the impact of a later award**

Source: Cartesian

Our National-Level Approach | Estimate Funding & Model Availability Impact

1 Estimate Eligible Locations

How many unserved, under-served and high-cost locations are in each State/Territory?

We use the May 2023 FCC National Broadband Map as the basis for allocating BEAD Funding to States/ Territories. We then estimate eligible unserved/underserved locations for project awards as follows:

- **Areas Funded by Other Support Programs:** We remove estimated "committed" locations covered by federal subsidy programs, as reflected in the FCC Funding Map released in May 2023
- **Incremental Builds:** We estimate and include additional, post-December 2022 private sector and government deployments, based on the national run-rate from 2020 to 2021

2 Calculate BEAD Funding

How much funding is each State/Territory estimated to receive?

Using the FCC location data and estimates from our deployment cost model, we calculate State/Territory-level funding specified by the BEAD statute:

- **Minimum Initial Allocation:** States/Territories receive $100M or $25M, respectively
- **High-Cost Allocation:** Funds are allocated in proportion to the estimated State/Territory's national share of high-cost unserved locations
- **Remaining Funds Allocation:** Funds are allocated to each State/Territory in proportion to their share of unserved locations

3 Develop Deployment Scenarios

How many locations can be covered with fiber and other technologies?

Using BEAD Funding + the Provider Match, we run two scenarios to estimate how many locations can receive high-speed broadband with fiber and other technologies:

Baseline Fiber: Satisfying the NOFO's fiber preference, fiber is deployed to unserved locations up to a reasonable estimate of the extremely high-cost threshold; remaining eligible locations are covered using other technologies

Maximum Fiber: Maximizing fiber availability to all eligible locations with support above the threshold; remaining eligible locations are covered using other technologies

Source: Cartesian

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Methodology | Eligible Locations for Funding Allocation and Project Awards

Starting with the most recent FCC serviceability data, we estimate the number of locations that will determine the funding allocation and the number that will be eligible for project awards to subgrantees

December 2022 FCC Broadband Location Availability Data	We start with the availability of service to locations from the May 2023 FCC National Broadband Map. We use this to estimate BEAD Funding Allocations to States/Territories.
Locations in Existing Subsidy Funded Programs	Locations reflected in the FCC Funding Map that have "commitments" to receive support from federal subsidy programs (e.g., RDOF and CAF) are removed for the purpose of awarding funding for deployments
Incremental Builds[1]	We estimate an ongoing reduction in unserved locations from incremental private sector and government funded builds based on the 13% rate observed in Form 477 data from Jun 20 to Jun 21
Estimated Eligible Locations	Our estimate of eligible locations that will need to be addressed in project awards is premised on BEAD funds being made available to subgrantees in 2024; as explained in the Appendix, the likelihood that much of the funding will go out in later years means that fewer locations will likely need support

1. Given the uncertainty around the magnitude of locations moving from unserved to underserved, we have not made incremental builds adjustments to underserved locations.

Source: Cartesian, FCC Form 477 Data

National Summary | Estimated Eligible Locations for Funding Allocation and Project Awards

	Unserved *(less than 25Mbps/3Mbps)*	Underserved *(less than 100Mbps/20Mbps)*
December 2022 FCC Broadband Locations	**8.4M**	**3.6M**
− Subsidy Program Funded Locations[1]	3.0M	0.9M
− Incremental Build[2] (13% annual build, for 12 months)	0.7M	--
= **Jan. 2024 Estimated State and Territory Eligible Locations** (There are 94K Territory Locations) (See Appendix for Adjustments for Later Years)	**4.7M**	**2.7M**

Eligible Locations for BEAD Funding Allocation

8.4M unserved locations are used to estimate the BEAD funding allocation for each State/Territory. Underserved locations are eligible for project awards but are not considered in the BEAD funding formula.

Eligible State Locations for BEAD Project Awards[3]

We estimate that 7.4M State locations will be eligible for BEAD funding:

4.7M Jan. 2024 Estimated Unserved + **2.7M** Jan. 2024 Estimated Underserved

1. Locations with "commitments" to receive support from federal subsidy programs (e.g., RDOF and CAF); does not include funding allocations or commitments not reflected in the FCC Funding Map, e.g., ARPA.
2. Given the uncertainty around the magnitude of locations moving from unserved to underserved, we have not made incremental builds adjustments to underserved locations
3. Eligible location totals for BEAD Project awards are for the 50 states and Washington DC and do not include 94K unserved locations within territories.

Source: Cartesian, FCC National Broadband Map (December 2022 data, released in May 2023)

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2 Calculate BEAD Funding

National Summary | BEAD Funding Allocation Formula

Statutory Requirements

1 Funding Allocation:

State/Territory BEAD Funding allocations will be determined using the –

(1) Minimum Allocation,

(2) High-Cost Allocation, and

(3) Remaining Funds Allocation

2 Provider Match:

Providers must match at least 25% of project costs, except if the location is within a high-cost area or if States/Territories choose to permit a lower match

States/Territories will share $42B in funding

Minimum Allocation: $5.3B

$100M *FOR STATES* OR $25M *FOR TERRITORIES*

+

High-Cost Allocation: $4.2B

Allocated to States/Territories based on share of high-cost, unserved locations

10% *OF PROGRAM FUNDS*

+

Remaining Funds Allocation: $33B

Allocated to each State/Territory based on share of unserved locations

=

Total BEAD Funds: $42B

Methodology

High-Cost Allocation:

10% of BEAD funding is reserved to reach the highest-cost households. Our proprietary cost model ranks the highest cost census tracts to serve and allocates funds to States/Territories based on their share of the high-cost households

Remaining Funds Allocation:

After deploying the minimum allocation and the high-cost allocation, the remaining funds are distributed to States/Territories based on their share of unserved locations

Source: Cartesian

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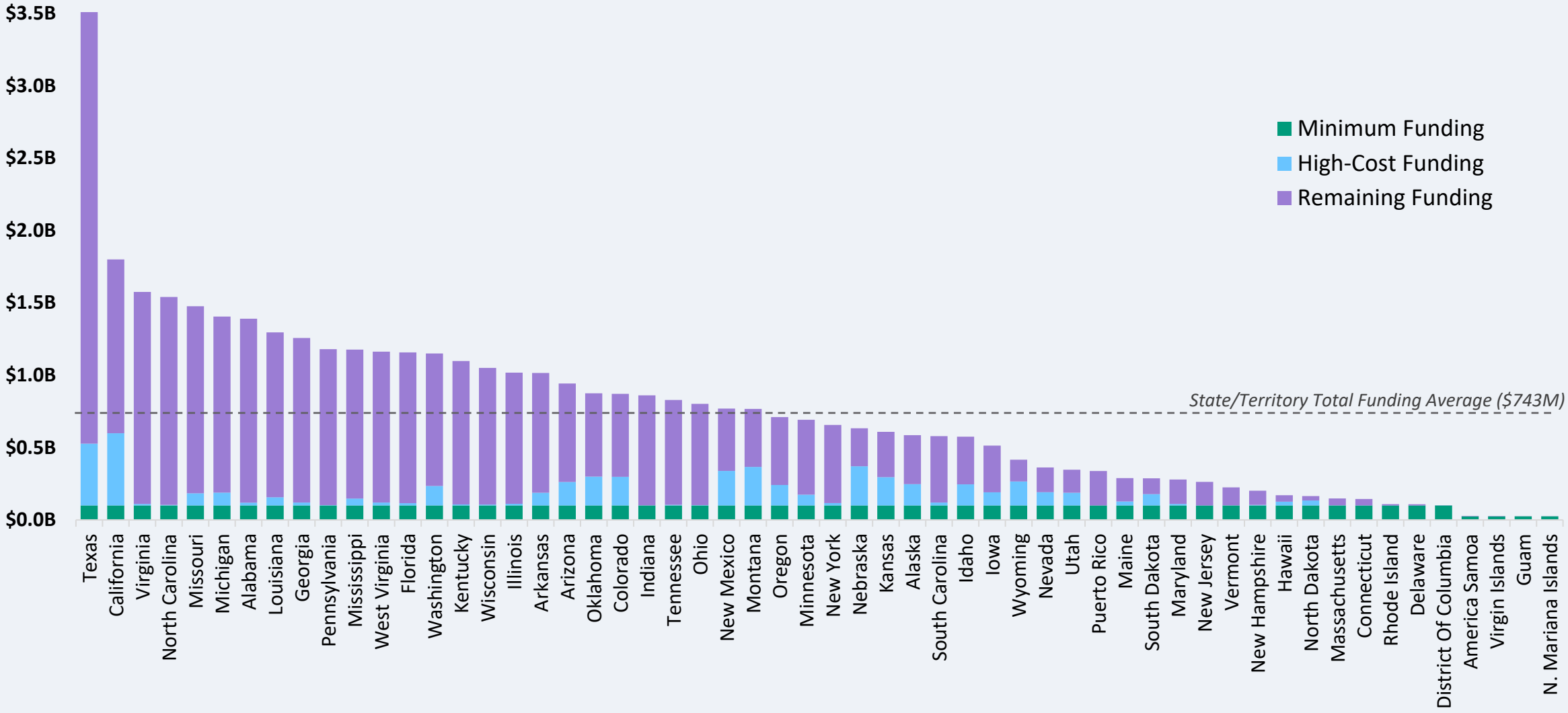
National Summary | Estimated BEAD Funding Distribution

Total Estimated BEAD Funding by State/Territory



Source: Cartesian, FCC National Broadband Map (December 2022 data, released in May 2023)

National Summary | BEAD Allocation Comparison

Total Estimated BEAD Funding Comparison – Version 2.0 vs. Version 3.0

Source: Cartesian, FCC National Broadband Map (December 2022 data, released in May 2023), FCC National Broadband Map (June 2022 data, released in November 2022)

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2 Calculate BEAD Funding

Provider Match Funding & Setting the High-Cost Threshold

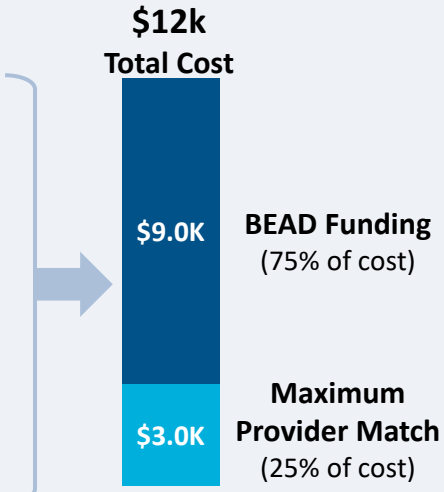
We assume a maximum provider match of $3k which supports a payback period of ~5 years; setting the extremely high-cost per location threshold at $9k is consistent with a $3k match (25% of total project cost)

Provider Economics Per Location

Annual Customer Spend ($64/month[1])	**$768**
× **Adoption Rate[2]**	**70%**
× **Average Margin[3]**	**90%**
= **Annual Contribution per Customer**	**$484**
	x1.2
Assumed Match	**$3,000** (maximum)
÷ **Annual Contribution per Location[4]**	**$581**
= **Payback Period**	**5.2 years**

Setting the Extremely High-Cost Threshold

- Each State/Territory must set an extremely high-cost per location threshold – the point at which other technologies than fiber *may* be considered if less expensive
- For our analysis, we have used a business-case based **$3k** maximum provider math which results in a **$9k** threshold (25% match requirement)
- Provider match has a maximum of 75% up to $3k:
  - At the $9k threshold, provider match is at the minimum of 25%
  - Beyond the threshold, provider match scales down and can be below 25% for locations in high-cost (unserved) areas
  - The extremely high-cost threshold is set above the point at which locations are considered "high-cost" in our analysis. Above the $12k total amount, we assume that match waivers will apply.



- For locations above the threshold, States/Territories may choose to reduce the 25% provider match and deploy fiber rather than using other technologies
- If States/Territories set the extremely high-cost threshold too low, fiber will not be adequately prioritized and communities that would otherwise have received fiber will miss out
- If States/Territories set the extremely high-cost threshold too high, providers will be unable to meet the 25% match amount for more costly locations, which will result in a lack of bids for locations in those communities

1. Blended ARPU based on $70 per month for broadband services (based on the New America 2020 report) with 15% of customers on a $30 low-cost plan
2. Since it is not likely that all locations will adopt broadband, we assume an 70% adoption rate, based on a Connected Nation 2020 study on internet adoption rates overtime
3. We assume the average margin based on 2021 NextTV Broadcasting+Cable article on broadband service margins
4. Annual contribution scaled by a factor of 1.2 to account for average no. of customers per location (derived from FCC National Broadband Map and Census data)

Source: Cartesian, New America, Connected Nation, NextTV

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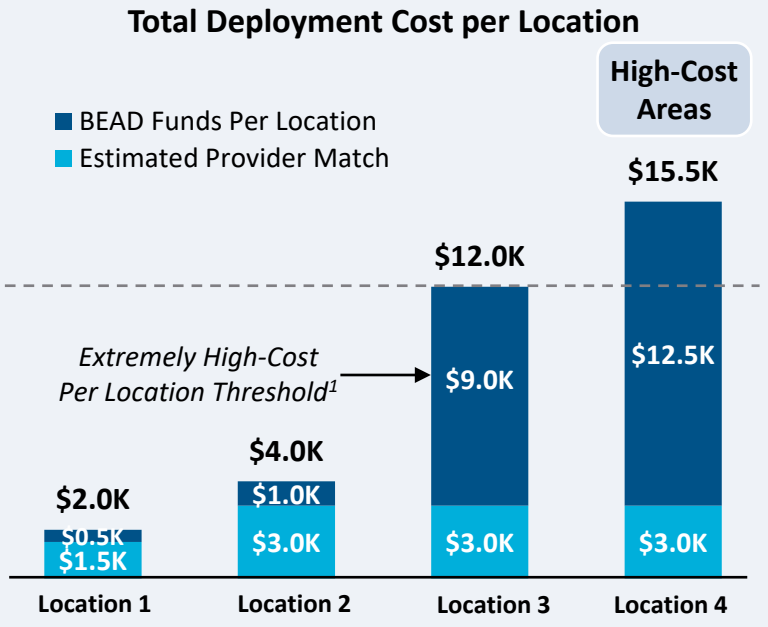
National Summary | Estimated BEAD Funding & Provider Match

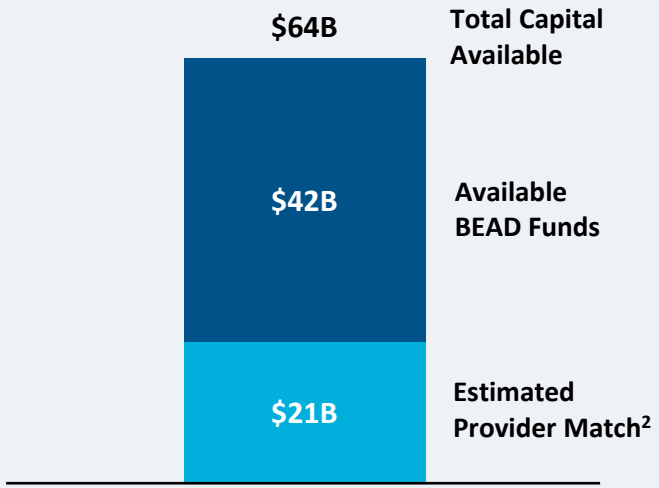
Provider Match Examples



Provider Match %			
75%	75%	25%	19%

To be conservative, we assume provider match amounts have a maximum of 75% and a minimum of 25%, except in high-cost areas

Total Capital Available - Nationally



$64B in total capital is estimated to be available to serve unserved/underserved locations (using both BEAD funding and provider match amounts)

Provider Match - Nationally

Total Estimated Provider Match: $21B

÷ **Total Estimated State Eligible Locations:** 7.4M

= **Average Provider Match:** $2,898 *PER LOCATION*

We estimate the average provider match will be $2,898 – provider matches will be 75% where cost to deploy is less than $4K

1. The model uses a $9K threshold, however, States/Territories will individually need to determine their appropriate extremely high-cost threshold
2. Assumed maximum $3K provider match also applies to locations deployed with FWA/other technologies. In reality, providers will determine the viable level of match funding for each project using a business case model. They will be willing to contribute a greater match in some locations and less in others. Locations that are hardest to serve may need to be fully funded by BEAD with no match. Competitive bidding should drive provider matches towards this level.

Source: Cartesian, FCC National Broadband Map (December 2022 data, released in May 2023)

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National Summary | Key Assumptions for Project Awards

Assumption	Description
Fiber Cost Model	Leveraging our proprietary network cost model, we calculate network distances between locations – and equipment requirements – to estimate the average cost per location for each census tract. The model does not examine middle mile infrastructure.
Extremely High-Cost Threshold[1]	Funding threshold for fiber per location, above which States/Territories *may* consider other technologies – or may consider applying additional funds for fiber above the threshold **$9K PER LOCATION**
Provider Match Maximum[3,4]	Assumed maximum amount that providers will contribute per location to achieve a positive business case; this reflects the high-end cost of private build – and additional amounts to serve locations with multiple units **$3K PER LOCATION**
Alternate Technology[2]	For locations above the extremely high-cost threshold, we assume fixed wireless will be used and apply a uniform cost per location **$4.8K PER LOCATION**

1. The model uses a $9k threshold, however, States/Territories will individually need to determine their appropriate extremely high-cost threshold
2. We assume FWA locations to cost $4.8K per location based on a 2022 Benton study, stating a cost estimate of $4K per location in very low-density rural areas for FWA network using beamforming and massive MIMO at 5GHz with a mix of indoor and outdoor CPE to achieve 100/20 Mbps, with a 20% uplift to account for cost for each location. FWA cost scaled by a factor of 1.2 to account for average no. of customers per location (derived from FCC National Broadband Map and Census data)
3. Assumed maximum $3K provider match also applies to locations deployed with FWA/other technologies. In reality, providers will determine the viable level of match funding for each project using a business case model. They will be willing to contribute a greater match in some locations and less in others. Locations which are hardest to serve may need to be fully funded by BEAD with no match. Competitive bidding should drive provider matches towards this level.
4. BEAD grants for projects may be taxable to providers; we do not account for this in our analysis.

Source: Cartesian, Benton

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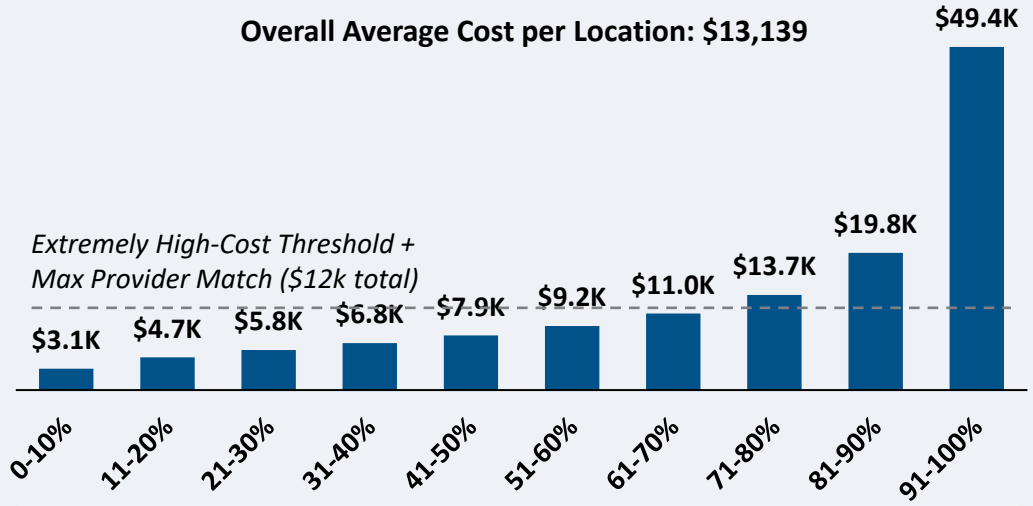
National Summary | Cost to Deploy Fiber by Decile

CAPEX Fiber Deployment Cost per Locations Segmented by Cost Deciles[1]

Unserved Locations

Overall Average Cost per Location: $13,139

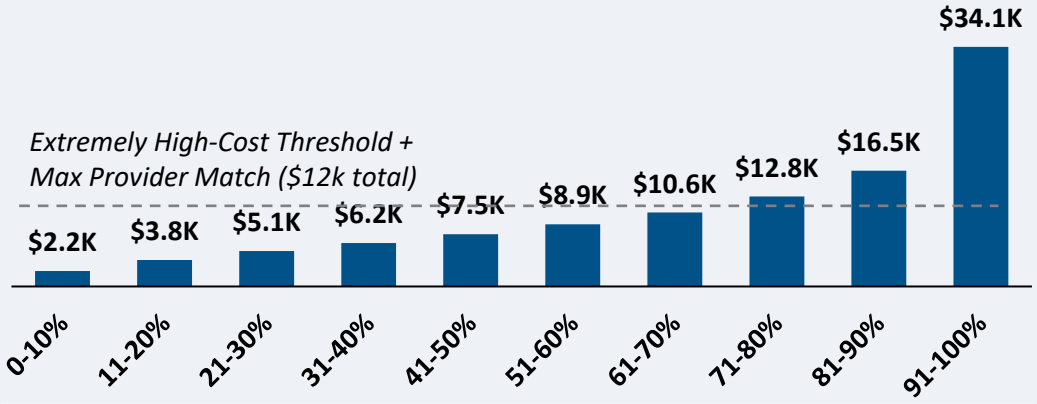


Average Tract Density *(Location per sq. Mile)*									
77	26	18	17	15	14	10	8	6	3

4.7M Locations

Underserved Locations

Overall Average Cost per Location: $10,797



Average Tract Density *(Location per sq. Mile)*									
177	44	36	26	22	20	17	11	8	4

2.7M Locations

Over 70% of State locations are estimated to fall below the High-Cost Threshold + Provider Match

1. Chart values are average cost per location for each decile bucket

Source: Cartesian, FCC National Broadband Map (December 2022 data, released in May 2023)

Note: Locations within Territories are not included in cost deployment analyses; after Territory location removal there are 7.4M unserved/underserved eligible locations

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National Summary | Baseline Fiber vs. Maximum Fiber

$45B - $59B CAPEX depending on States'/Territories' Funding Priorities

CAPEX Deployment Costs:

- **Fiber:** Below High-Cost Threshold
- **Fiber:** Above High-Cost Threshold
- **Fixed Wireless:** Above High-Cost Threshold

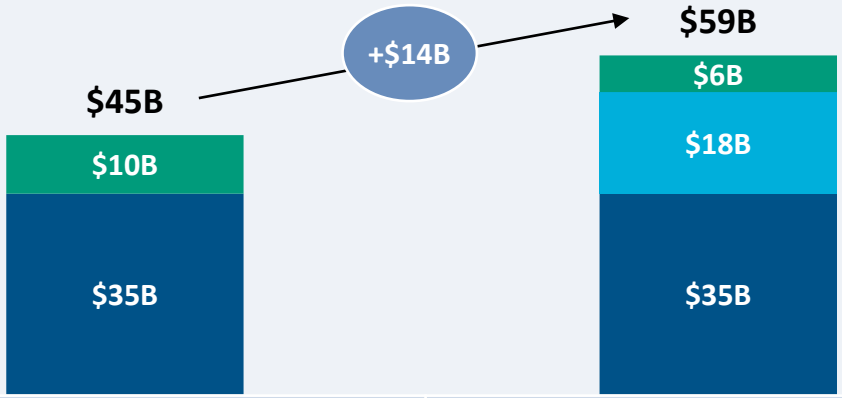
1 Baseline Fiber
Other Technology used above High-Cost Threshold

Deploy fiber to locations below high-cost threshold; then fixed wireless

2 Maximum Fiber
Fiber above High-Cost Threshold

Deploy fiber to the maximum extent above and below the high-cost threshold

Estimated Deployment Cost for 7.4M Eligible State Locations[1]:



Cost per Location:	$6,160	$7,976
Low-Cost Location (*5.2M*):	$6,716	$6,716
High-Cost[2] Locations (*2.2M*):	$4,800	$10,958
% of Locations Reached with Fiber:	71%	82%

Key Takeaways

1. **High-speed broadband can be deployed to 7.4M State eligible locations for $45B:**
   - Fiber is built to 5.2M locations below the extremely high-cost threshold
   - Other technologies used to reach 2.2M
   - Nearly 100% of eligible state locations served using ~70% of the estimated capital available, with provider matches
   - States can use any remaining funds they have for other eligible programs

2. **By allocating more BEAD funds to fiber, States add extra ~0.8M fiber locations:**
   - Fiber built to 6.0M locations
   - Other technologies used to reach ~1.4M
   - Nearly 100% of eligible State locations served using ~80% of the estimated capital available[3], with provider matches
   - Incremental coverage reduces funding available for other programs

1. Scenario totals on this slide are for the 50 states and Washington DC and do not include territories.
2. The extremely high-cost per location threshold is $9k, giving a total cost of $12k inclusive of match funds. For locations above this cost, we assume alternative technologies are used with a fixed cost of $4.8k per location.
3. Only $59B of the $64B total available capital is used because several states have leftover budget after reaching 100% fiber coverage

Source: Cartesian, FCC National Broadband Map (December 2022 data, released in May 2023), Benton

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Appendix

Sensitivity Analysis

Sensitivity Analysis | Overview

We have modelled two sensitivity-adjusted cases to explore the impact of States/Territories awarding subgrants beyond January 2024

Base Case Assumptions

- The analysis assumes there is incremental build in the period between the allocation of BEAD funds to the States/Territories and the point at which subgrant awards for deployment projects are made, reducing the number of BEAD-eligible locations
- We estimate an ongoing reduction in unserved locations from incremental private sector and government funded builds based on the 13% rate observed in Form 477 data from June 2020 to June 2021
- The base case assumes that BEAD projects are awarded in January 2024, giving 12 months of incremental build (from December 2022)

Sensitivity Analysis

- BEAD program subgrant awards are likely to start later than January 2024 and may be staged over several years
- With a later start, ongoing builds (commercial and subsidized) will further reduce the number of eligible locations; for instance, the Capital Projects Fund is estimated to support deployments to approximately 2M locations
- This sensitivity analysis explores the impact of additional incremental builds on the Baseline Fiber and Max Fiber scenarios
  - Scenarios are run to show the outcome of an additional 10% or 15% build before deployment

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Sensitivity Analysis | Impact of Late Start on Eligible Locations

	Base Case – 1 January 2024		*Later Start - 10% Incremental Build*		*Later Start - 15% Incremental Build*	
	Unserved *(less than 25Mbps/3Mbps)*	**Underserved** *(less than 100Mbps/20Mbps)*	**Unserved** *(less than 25Mbps/3Mbps)*	**Underserved** *(less than 100Mbps/20Mbps)*	**Unserved** *(less than 25Mbps/3Mbps)*	**Underserved** *(less than 100Mbps/20Mbps)*
December 2022 FCC Broadband Locations	**8.4M**	**3.6M**	**8.4M**	**3.6M**	**8.4M**	**3.6M**
− Subsidy Program Funded Locations[1]	3.0M	0.9M	3.0M	0.9M	3.0M	0.9M
− Incremental Build[2]	0.7M	--	1.2M	--	1.5M	--
= **Estimated Eligible Locations at Time of Deployment**	**4.7M**	**2.7M**	**4.2M**	**2.7M**	**3.9M**	**2.7M**
	7.4M Eligible locations when BEAD-funded programs start		**6.9M** Eligible locations when BEAD-funded programs start		**6.6M** Eligible locations when BEAD-funded programs start	

1. Locations with "commitments" to receive support from federal subsidy programs (e.g., RDOF and CAF), as reflected on the FCC Funding Map
2. Given the uncertainty around the magnitude of locations moving from unserved to underserved, we have not made incremental builds adjustments to underserved locations

Source: Cartesian, FCC National Broadband Map (December 2022 data, released in May 2023)

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Sensitivity Analysis | BEAD Funding & Provider Match

Provider Match – Base Case	Provider Match – 10% Incremental Build	Provider Match – 15% Incremental Build
Total Estimated Provider Match: **$21B**	Total Estimated Provider Match: **$20B**	Total Estimated Provider Match: **$19B**
÷ Total Estimated State Eligible Locations: **7.4M**	÷ Total Estimated State Eligible Locations: **6.9M**	÷ Total Estimated State Eligible Locations: **6.6M**
= Average Provider Match: **$2,898** *PER LOCATION*	= Average Provider Match: **$2,896** *PER LOCATION*	= Average Provider Match: **$2,895** *PER LOCATION*
$64B in total capital is estimated to be available to serve unserved/underserved locations; we estimate the average provider match will be $2,898	**$62B in total capital is estimated to be available to serve unserved/underserved locations; we estimate the average provider match will be $2,896**	**$62B in total capital is estimated to be available to serve unserved/underserved locations; we estimate the average provider match will be $2,895**

1. The model uses a $9K threshold, however, States/Territories will individually need to determine their appropriate extremely high-cost threshold
2. Assumed maximum $3K provider match also applies to locations deployed with FWA/other technologies. In reality, providers will determine the viable level of match funding for each project using a business case model. They will be willing to contribute a greater match in some locations and less in others. Locations that are hardest to serve may need to be fully funded by BEAD with no match. Competitive bidding should drive provider matches towards this level.

Source: Cartesian, FCC National Broadband Map (December 2022 data, released in May 2023)

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Sensitivity Analysis | Baseline Fiber vs. Maximum Fiber

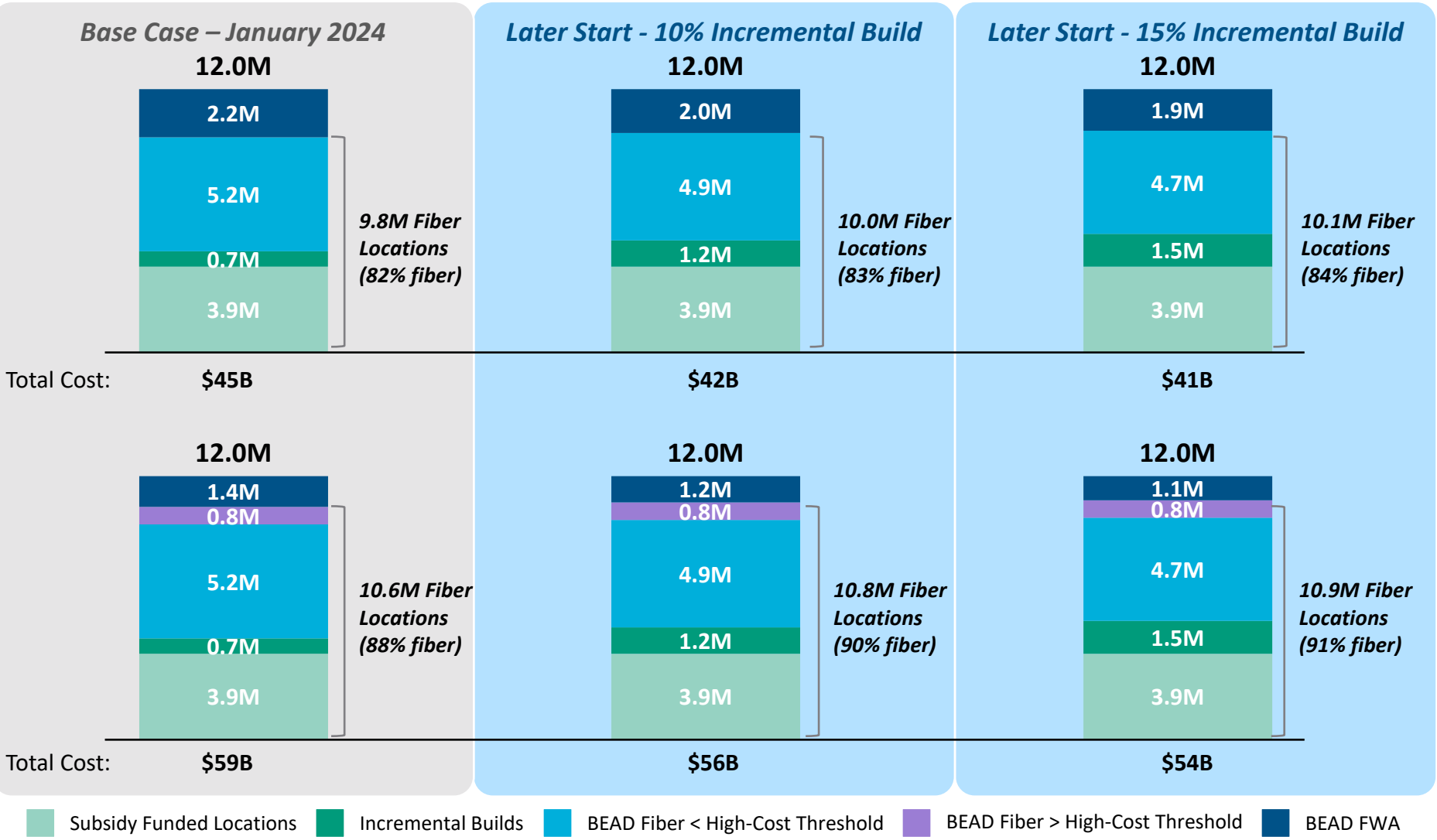
Locations Served in Baseline Fiber vs. Maximum Fiber Deployment Scenarios

1 Baseline Fiber
Other Technology used above High-Cost Threshold

Deploy fiber to locations below high-cost threshold; then fixed wireless

2 Maximum Fiber
Fiber above High-Cost Threshold

Deploy fiber to the maximum extent above and below the high-cost threshold



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www.**acaconnects**.org

GRANT SPELLMEYER
PRESIDENT AND CEO
GSPELLMEYER@ACACONNECTS.ORG

BRIAN HURLEY
CHIEF REGULATORY COUNSEL
BHURLEY@ACACONNECTS.ORG

MIKE JACOBS
VICE PRESIDENT OF REGULATORY AFFAIRS
MJACOBS@ACACONNECTS.ORG

www.**cartesian**.com

MICHAEL DARGUE
VICE PRESIDENT
MICHAEL.DARGUE@CARTESIAN.COM

SAMUEL KORNSTEIN
MANAGING DIRECTOR
SAMUEL.KORNSTEIN@CARTESIAN.COM