BEAD Program: A Framework to Allocate Funding for Broadband Availability

National Overview

January 2024

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

Dear State Broadband Leaders

In September 2022, ACA Connects and Cartesian launched the first version of our Broadband Equity, Access, and Deployment (BEAD) Program Framework, and since then, we have met with many of you to discuss how the model works and the potential ways you might spend the funds you have been allocated on broadband deployments — first using fiber, as the Notice of Funding Opportunity requires, and then with other broadband network technologies. We also have worked to refine the framework based on your feedback, new data from the National Broadband Map, and more accurate modeling of deployment costs.

Today, we release version 4 of the BEAD Program Framework, which uses data from the latest (November 2023) National Broadband Map to detail the number of eligible (unserved and underserved) locations and provide a more accurate estimate of locations that can be connected with fiber and other technologies. As you will see, the number of eligible locations has decreased from version 3 as broadband service providers edge out and government deployment programs take hold, and the number should decrease even further as you account for additional government-supported "committed" and private sector "planned" builds. At the end of the day, we estimate that the BEAD program should support the deployment of fiber infrastructure to at least 71% of eligible locations in the country – an excellent result for households that have so far been left behind.

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

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 $42.5B

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

- Using the latest FCC National Broadband Map with data up to June 2023 (released Nov. 2023), we estimate the number of eligible locations, the cost to deploy to these locations, and the provider match
- 10.3M locations in the U.S. are currently unserved or underserved, and by June 2024 the estimated number of BEAD eligible locations decreases to 6.4M[1]. The actual number of eligible locations may be even lower at the time of deployment due to incremental builds between June 2024 and when funds are distributed
- 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 $18.5B of funds – for a total of $61B in capital available for deployment projects

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

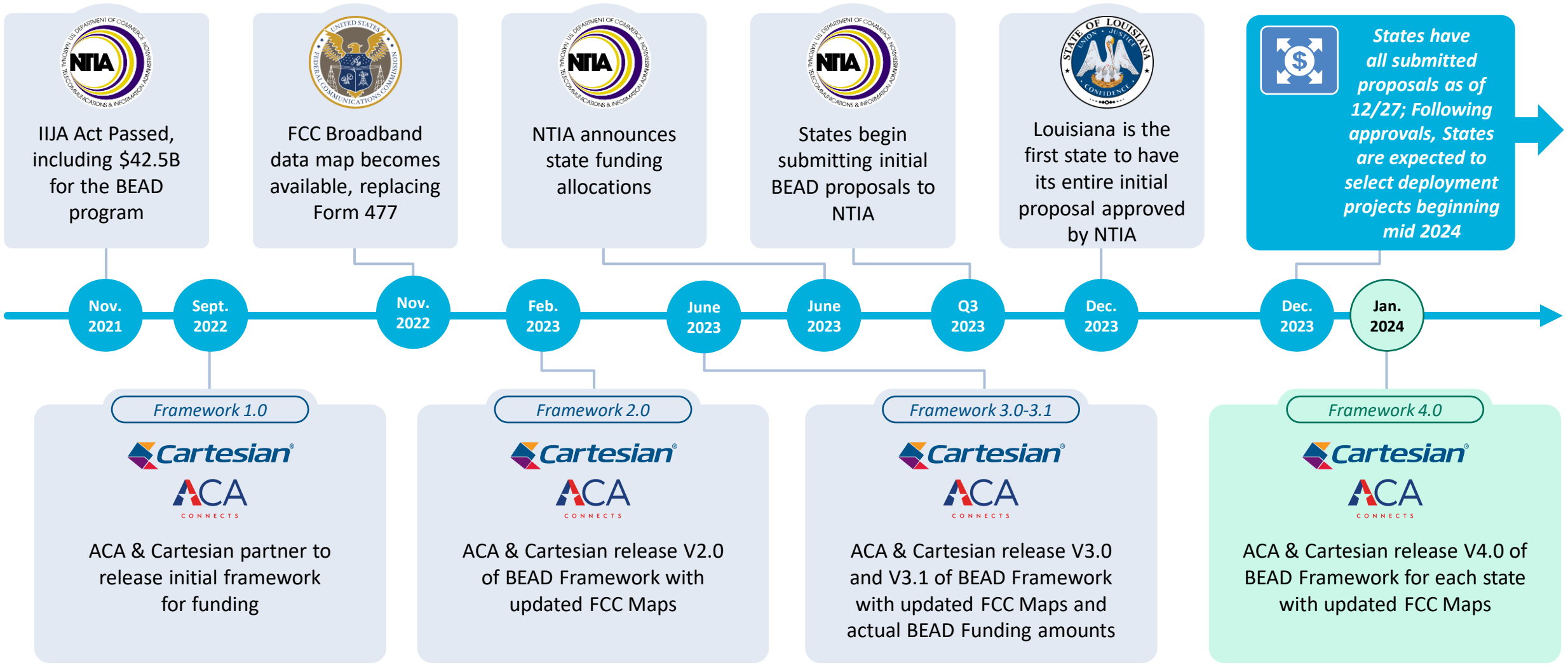
- We find that $61B in funding should still be sufficient to make broadband service available to all eligible locations
- All States should have sufficient funds to deploy fiber – the NOFO's preferred technology – to all unserved and underserved locations below a reasonable "extremely high-cost threshold" and use other technologies to serve the remaining "higher cost" locations, with the majority of States expected to have funds left over for affordability and other eligible programs
- States also may choose to achieve "maximum fiber" availability by using additional funds

1. Excludes 144K locations within US territories

Source: Cartesian

BEAD Allocation and Fiber Deployment Analysis | Timeline

The BEAD Program was created as part of the IIJA in 2021; Cartesian and ACA have been partnering since then to help build frameworks and estimates for how these funds will be used in each state



Source: Cartesian

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Overview | What is new in Version 4.0 of the BEAD Framework?

1

The most recent FCC National Broadband Map indicates there are fewer eligible locations

- The June 2023 FCC National Broadband Map data contains 10.3M unserved and underserved locations vs. 12.0M eligible locations in the data from December 2022
- Although the total number of eligible locations has decreased, in a few States the number of locations has increased, likely due to reasons such as updated provider coverage and resolved data discrepancies

2

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 a slight increase in the average cost to serve
- Compared against our V3.1 analysis, the average cost in V4.0 to serve an unserved location is $13.3K and an underserved location $11.9K (increases of roughly $175 and $1,100 respectively)[1]
- The methodology used to estimate costs in Alaska and Connecticut has been updated to utilize national averages based on household densities due to data limitations

3

Because it is clear that no States/Territories will select projects by January 2024, we have pushed back our assumed project award date to June 2024, and even that is optimistic

- With most States/Territories submitting Initial Proposals in Q4 2023 and with NTIA only fully approving Louisiana's Initial Proposal in 2024, we have shifted estimates and analysis from January 2024 to June 2024 to reflect when States/Territories will begin selecting deployment projects

1. Excludes Alaska and Connecticut

Source: Cartesian, ConnectLA

BEAD Allocation and Fiber Deployment Analysis | Version 4.0 Methodology

Version 4.0 includes actual funding allocations, updated data, and shifts timeline for funding to June 2024

	BEAD Funding Framework: V1.0 *Released September 28, 2022*	BEAD Funding Framework: V2.0 *Released February 2, 2023*	BEAD Funding Framework: V3.0-1 *Released June 21, 2023*	BEAD Funding Framework: V4.0 *Released January 2024*
Serviceability Data Source	FCC Form 477 serviceability data (Jun. 2021) overlaid with household and business premise estimates	FCC National Broadband Map data (Jun. 2022 released in Nov. 2022)	FCC National Broadband Map data (Dec. 2022 released in May 2023 and FCC Funding Map (May 2023))	FCC National Broadband Map data (Jun. 2023 released in Nov. 2023 and FCC Funding Map (Nov 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 min. spanning tree routing to optimally connect locations using 2010 census block boundaries	Updated cost model using 2020 census block 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		Estimated deployment project awards to be made in January 2024 with included sensitivity for later start	Estimated deployment project awards to be made in June 2024
BEAD Funding Allocations	Estimated using estimated BEAD locations and NTIA announced BEAD funding statute		Actual NTIA funding amounts used in analysis	

Source: Cartesian

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

1 Estimate Eligible Locations	2 Calculate BEAD Funding	3 Develop Deployment Scenarios
How many unserved, under-served and high-cost locations are in each State/Territory?	***How much funding will each State/Territory have?***	***How many locations can be covered with fiber and other technologies?***
We use the June 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 additional private sector and government deployments based on the national run-rate of 13%	The NTIA announced BEAD funding allocations for each state in June 2023. We have used this and added an estimated provider match to determine total funding in each state: • **Minimum Initial Allocation:** States/Territories received a min. of $100M or $25M, respectively • **High-Cost Allocation:** Funds were allocated in proportion to the estimated State/Territory's national share of high-cost unserved locations • **Provider Match:** Providers are expected to match up to $3K per location	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

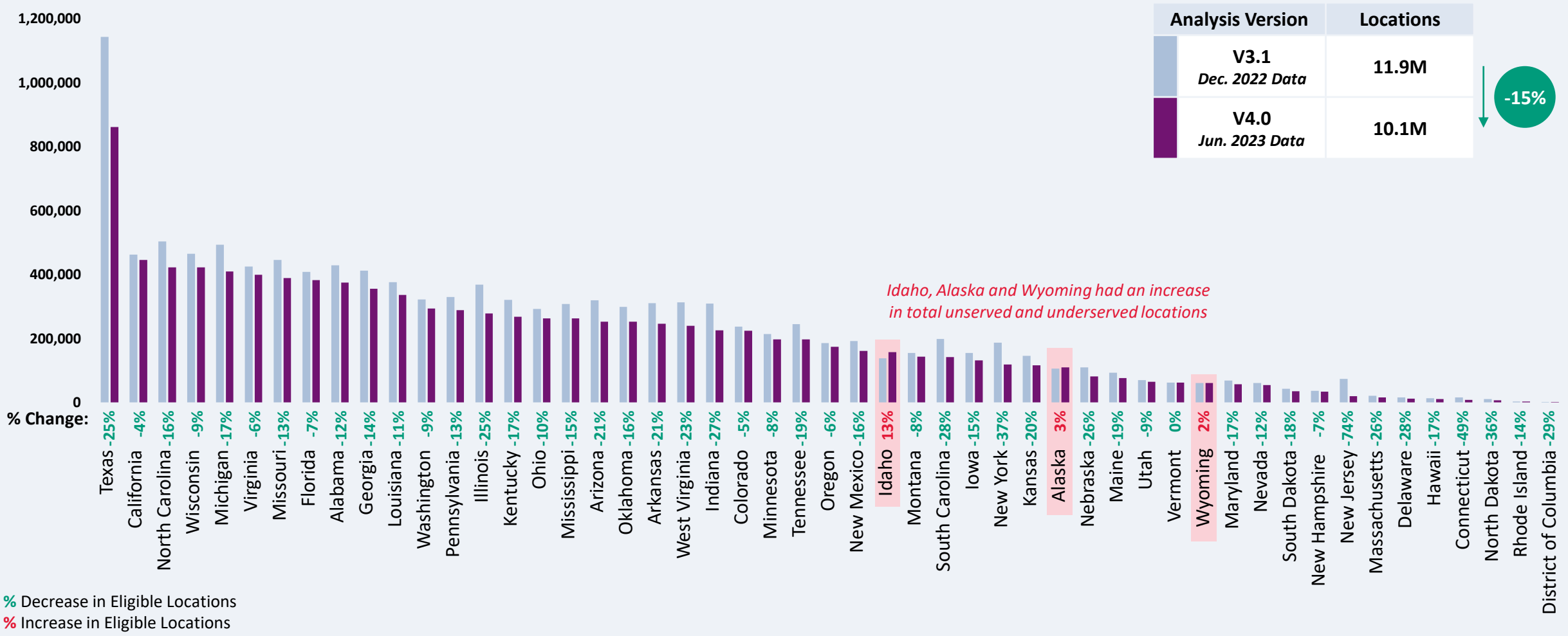
Starting with the most recent FCC serviceability data, we estimate the number of locations that will be eligible for BEAD Funding in each state

June 2023 FCC Broadband Location Availability Data	We start with the availability of service to locations from the June 2023 FCC National Broadband Map. We use this to calculate the number of unserved and underserved locations in 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 deployment pace observed in Form 477 and National Broadband Map data from June 2020 to June 2023
= **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 June 2024, though exact timing of funds being made available may vary from state to state

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 National Broadband Map, FCC Funding Map, Fiber Broadband Association

National Summary | Location Comparison

Total Unserved & Underserved Locations – V3.1 vs. V4.0



Note: Excludes 114K locations from US Territories

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

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National Summary | Est. Eligible Locations for BEAD Funding

	Unserved *(less than 25Mbps/3Mbps)*	Underserved *(less than 100Mbps/20Mbps)*
June 2023 FCC Broadband Locations	**7.1M**	**3.0M**
− Subsidy Program Funded Locations[1]	2.4M	0.8M
− Incremental Build[2] (13% annual build, for 12 months)	0.6M	--
= **June 2024 Estimated State and Territory Eligible Locations** (144K Territory Locations Excluded[3])	**4.1M**	**2.2M**

BEAD Funding Allocation

BEAD Funding was announced in June 2023, based on December 2022 data released in May 2023. Allocations will not change, but **total eligible locations have decreased** with latest available data.

Eligible State Locations for BEAD Project Awards[3]

We estimate that 6.37M locations will be eligible for BEAD funding as of June 2024:

4.1M Unserved Locations + **2.2M** Underserved Locations

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 144K locations within territories.

Source: Cartesian, FCC National Broadband Map (June 2023 data, released in Nov 2023)

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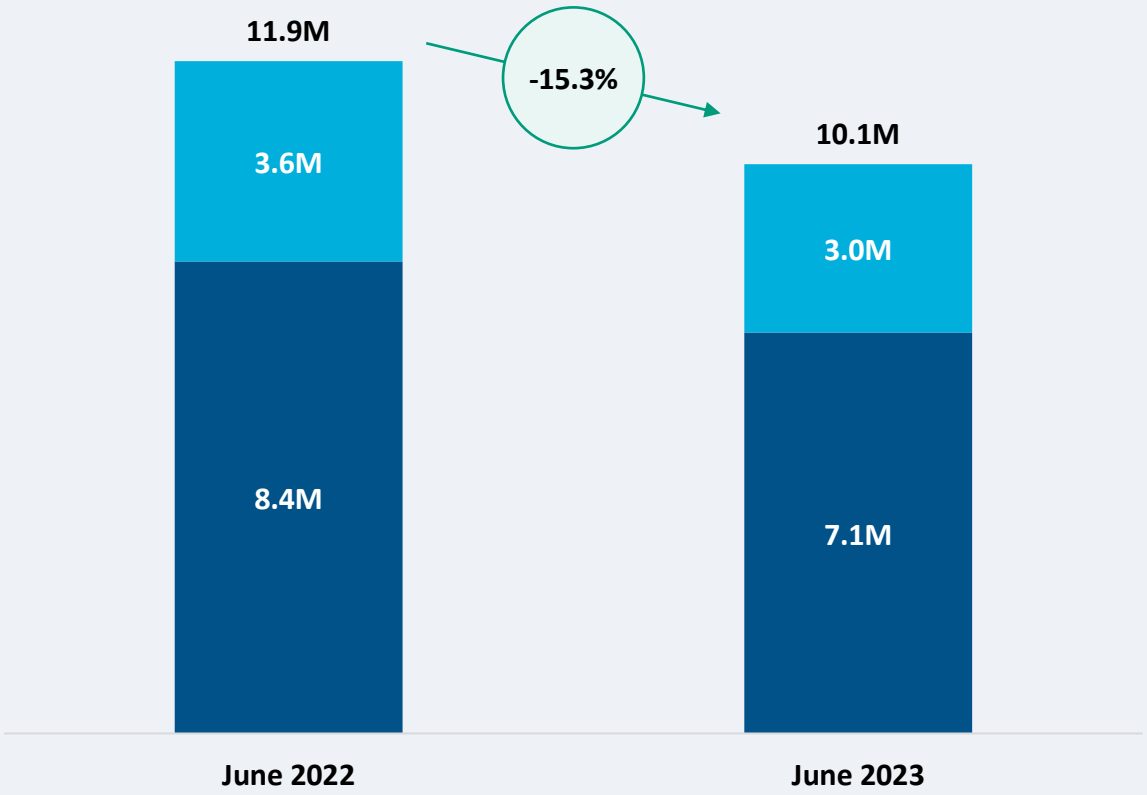
National Summary | Unserved & Underserved Locations

Total Unserved or Underserved Locations in June 2022 vs. June 2023



% Decline from June 2022 to June 2023	
Overall	15.3%
Underserved	16.0%
Unserved	15.1%

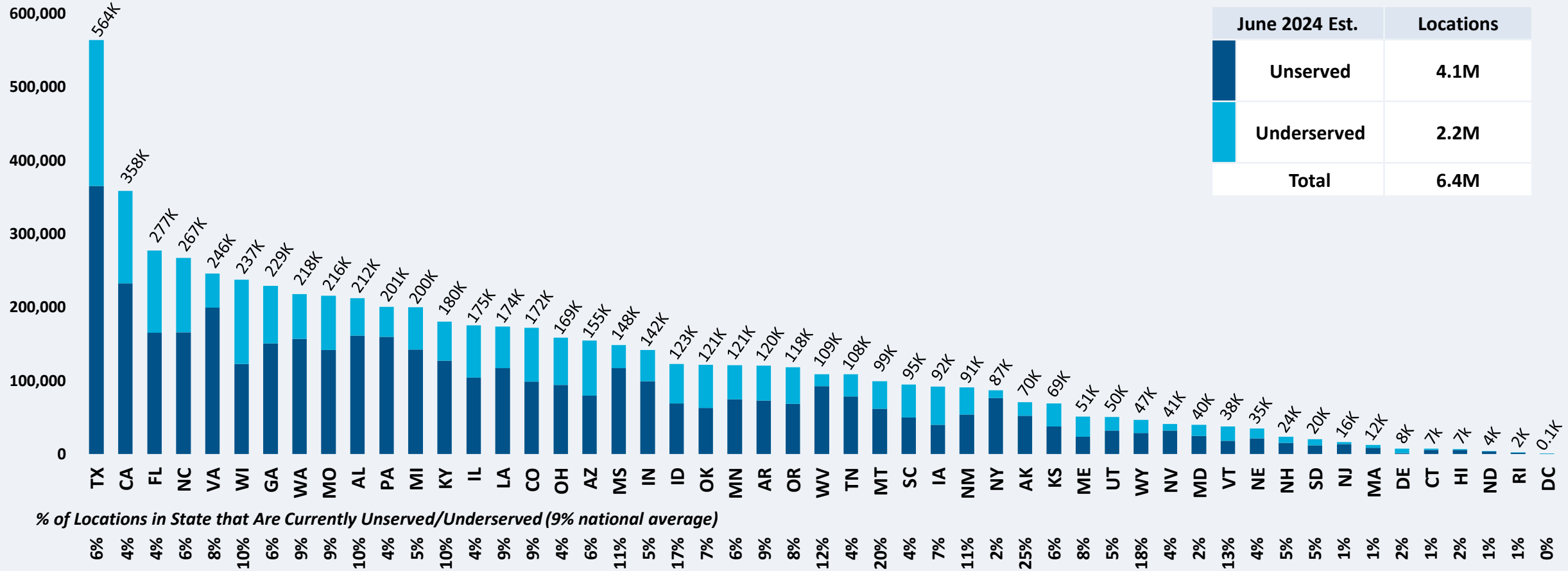
Unserved & Underserved Locations Trends:

- Overall, the number of unserved and underserved locations in the US has declined by 15.3% from June 2022 to June 2023
- Underserved locations declined at slightly faster rate than unserved locations, 16.0% vs. 15.1% respectively
- In Version 4.0, we continue to apply the 13% annual incremental build assumption used in prior versions to estimate the number of eligible locations in June 2024

Notes: Excludes 144K locations from US Territories
Sources: Cartesian, FCC National Broadband Maps June 2022, December 2022, and June 2023

National Summary | Unserved & Underserved Locations in June 2024

June 2024 Unserved & Underserved Locations Estimations



June 2024 Est.	Locations
Unserved	4.1M
Underserved	2.2M
Total	6.4M

Note: Estimated June 2024 locations excludes locations expected to be served through other subsidies and additional estimated incremental builds
Sources: Cartesian, FCC Broadband Map June 2023

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2 Calculate BEAD Funding

National Summary | BEAD Funding Allocation Formula

Statutory Requirements

1 NTIA Funding Allocation:

State/Territory BEAD Funding allocations are 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

Total Estimated Funding

$42.5B + **$18.5B** = **$61B** Total Available Capital

Methodology

BEAD Funding

ANNOUNCED JUNE 2023

NTIA Methodology:

Minimum Allocation: $5.2B
+
High-Cost Allocation: $4.2B
+
Remaining Funds Allocation: $33B

$100M *PER STATE* OR $25M *PER TERRITORY*

10% *OF PROGRAM FUNDS*

BASED ON SHARE OF UNSERVED LOCATIONS

Provider Match

Cartesian Methodology:

Estimate Total Cost to Build per Location: ***Proprietary Cartesian Cost Model***

Estimated Provider Match per Location: ***25%*** *OF PROJECT COST MINIMUM* UP TO ***$3,000*** *ESTIMATED MAX PROVIDER MATCH*

Total Estimated Funds For BEAD Deployment

Source: Cartesian

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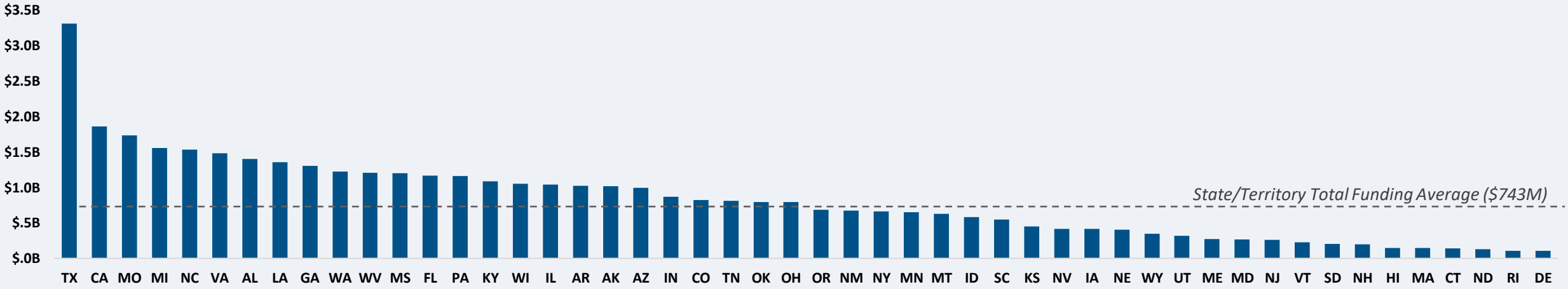
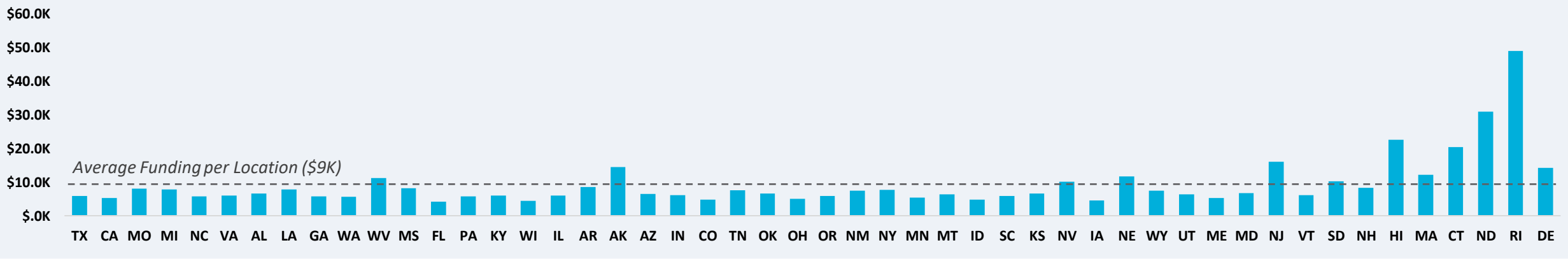
National Summary | BEAD Allocation by State

BEAD Funding[1]



Average Funding Per Eligible Location in June 2024



Note: Does not include estimated provider match, excludes US Territories, DC Average Funding per Location is $763K due to minimal locations and is excluded from average of other states
Source: Cartesian, NTIA

2 Calculate BEAD Funding

Provider Match Funding & Setting the High-Cost Threshold

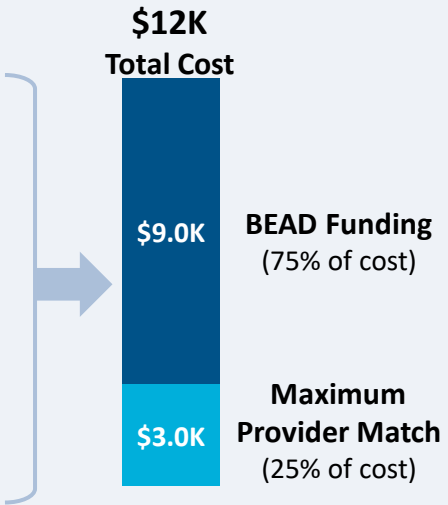
We assume a maximum provider match of $3K which supports a payback period of ~5 years; setting the extremely high-cost per location threshold at $9K is consistent with a $3K match (25% of total project cost)

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 technologies other than fiber *may* be considered if less expensive to deploy
- For our analysis, we have used a business-case supported **$3K** maximum provider match, resulting 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 extremely high-cost BEAD eligible 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 over time
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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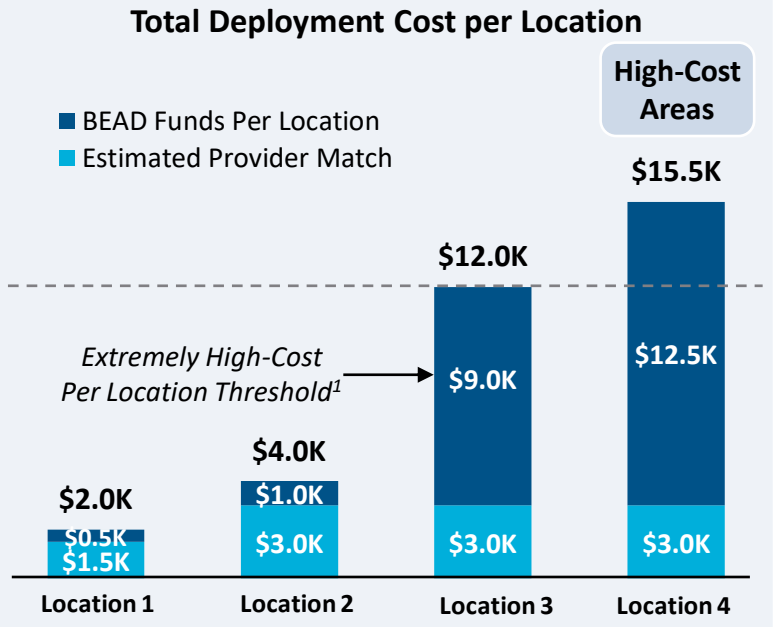
National Summary | Estimated BEAD Funding & Provider Match

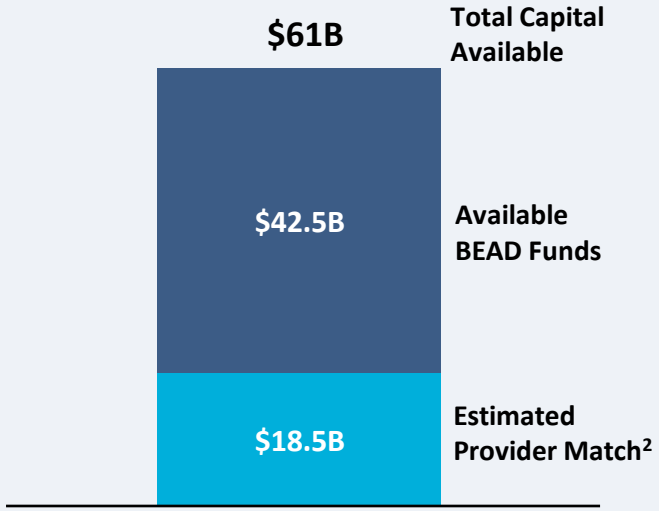
Provider Match Examples



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 extremely high-cost areas

Total Capital Available - Nationally



$61B in total capital is estimated to be available to serve unserved/underserved locations (combining BEAD funding and provider match amounts)

Provider Match - Nationally

Total Estimated Provider Match: $18.5B

÷ **Estimated Eligible Locations:** 6.4M
Excl. Territories

= **Average Provider Match:** $2,901 *PER LOCATION*

We estimate the average provider match will be $2,901 – 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 (June 2023 data, released in November 2023)

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.

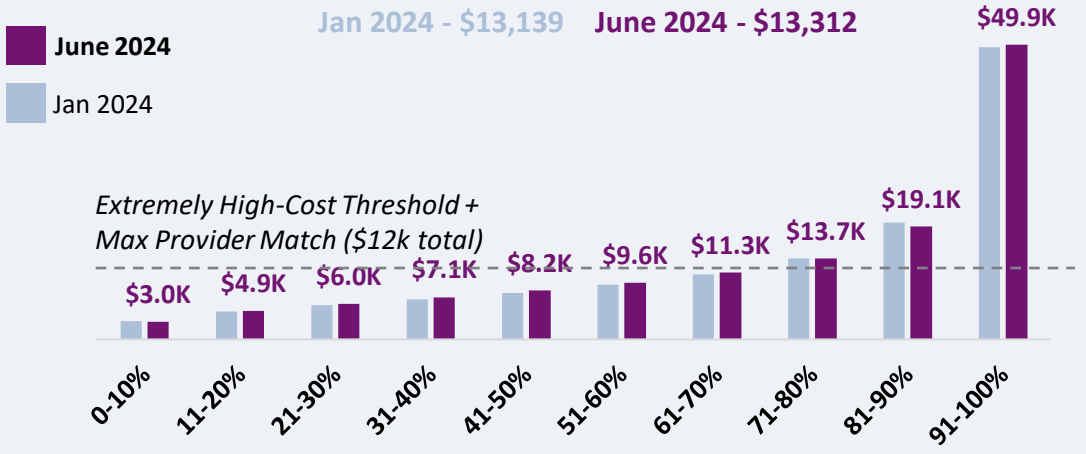
Source: Cartesian, Benton

National Summary | Cost to Deploy Fiber by Decile

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

Unserved Locations

Average Cost per Location[2]:
Jan 2024 - $13,139 **June 2024 - $13,312**

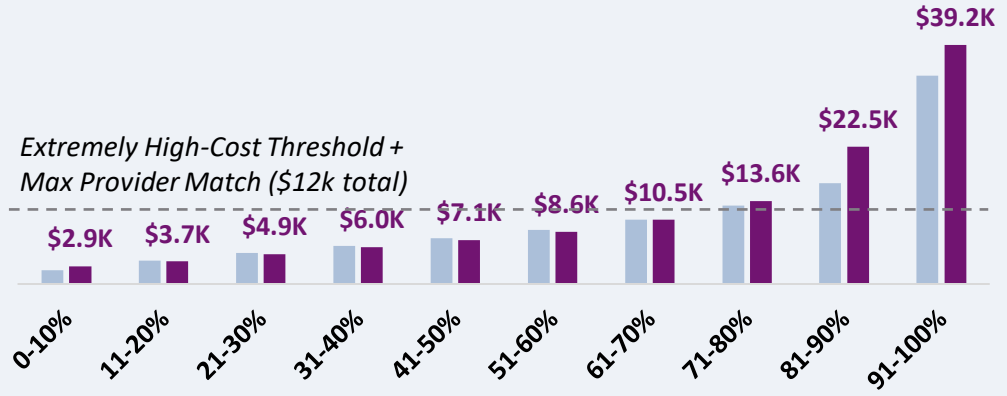


Average Tract Density *(Location per sq. Mile)*									
68	32	26	22	19	16	14	12	10	6

4.1M Locations

Underserved Locations

Average Cost per Location[2]:
Jan 2024 - $10,797 **June 2024 - $11,901**



Average Tract Density *(Location per sq. Mile)*									
90	36	27	23	18	17	15	13	11	7

2.2M Locations

Overall average estimated cost per location in June 2024 is $12,794; Jan 2024 is $12,257

1. Chart values are average cost per location for each decile bucket
2. Estimated locations in Jan 2024 are from V3.0 analysis with December 2022 FCC BDC data, June 2024 from V4.0 with June 2023 FCC BDC data (current)

Note: Due to discrepancies in publicly available data, Alaska and Connecticut were removed from this analysis

Source: Cartesian, FCC National Broadband Maps (June 2023 data, released in November 2023)

National Summary | Baseline Fiber vs. Maximum Fiber

$39B - $56B CAPEX depending on States/Territories Funding Priorities

CAPEX Deployment Costs:

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

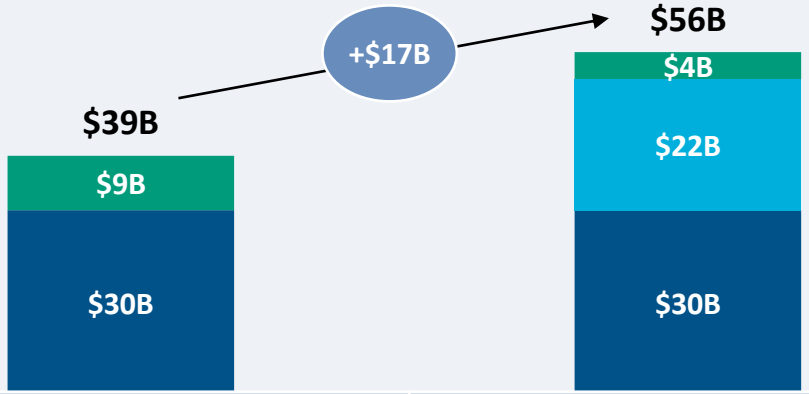
1 Baseline Fiber
Other Technology used above Extremely High-Cost Threshold

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

2 Maximum Fiber
Fiber above Extremely High-Cost Threshold

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

Estimated Deployment Cost for 6.4M Eligible State Locations[1]:



Cost per Location:	$6,197	$8,874
Low-Cost Location (*4.5M*):	$6,775	$6,775
Extr. High-Cost[2] Location (*1.9M*):	$4,800	$13,942
% Locations Reached with Fiber:	71%	86%
% Reached with High Speed BB:	100%	100%

Key Takeaways

1. **High-speed broadband can be deployed to 6.4M State eligible locations for $39B:**
   - Fiber is built to 4.5M locations below the extremely high-cost threshold
   - Other technologies used to reach 1.9M
   - All eligible state locations served using ~67% 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 ~1M fiber locations:**
   - Fiber built to 5.4M locations
   - Other technologies used to reach ~1M
   - All eligible State locations served using ~95% 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 $56B of the $61B total available capital is used because several states have leftover budget after reaching 100% fiber coverage

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

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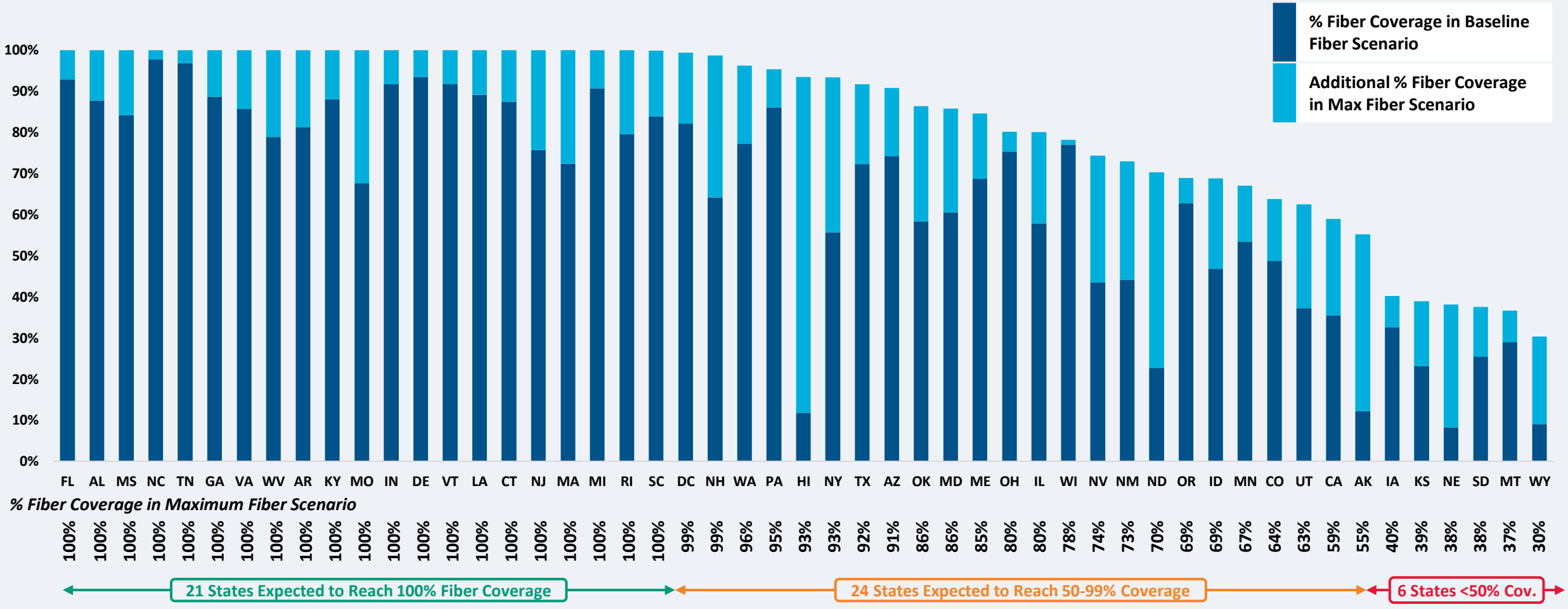
National Summary | Expected Fiber Coverage

Expected Fiber Coverage in Baseline & Maximum Fiber Scenarios



Note: All states are expected to reach full coverage with alternative technologies, chart details coverage with fiber specifically
Source: Cartesian, NTIA

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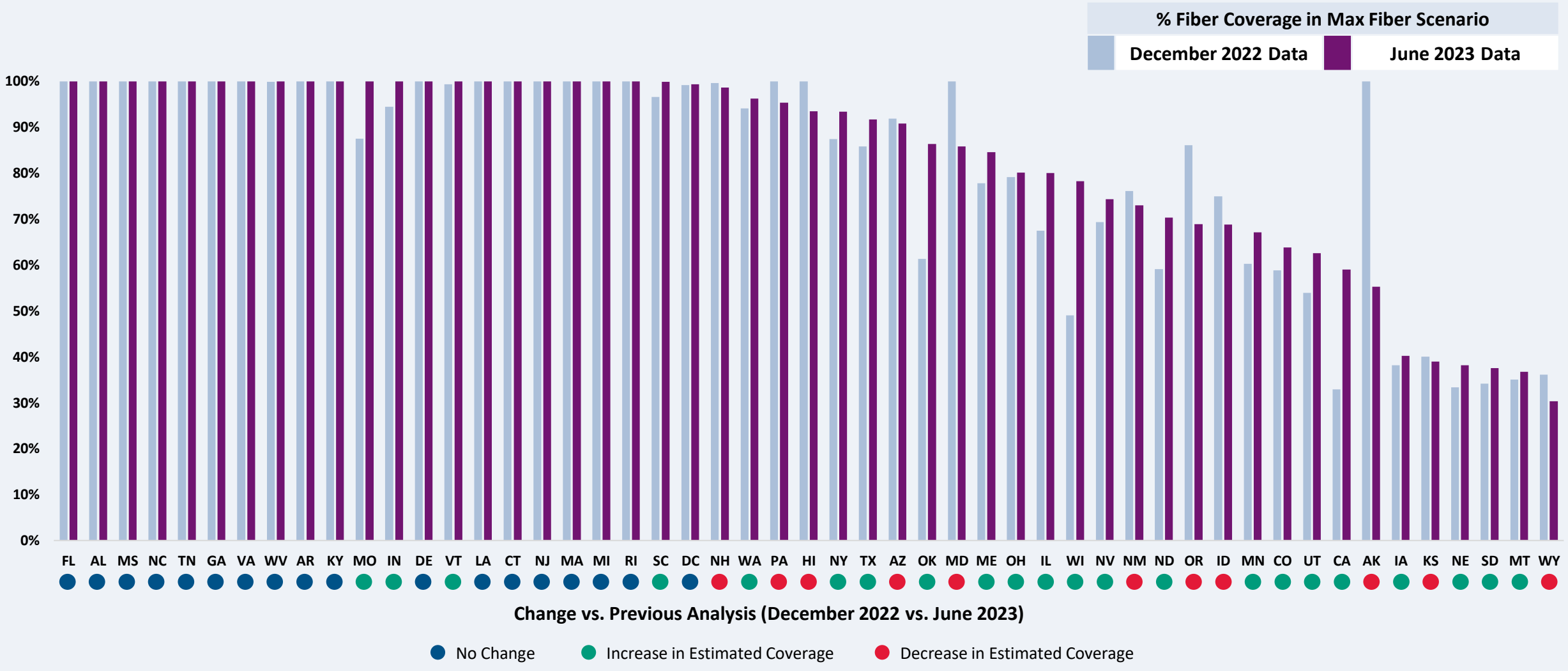
National Summary | Maximum Fiber Scenario Comparison

Estimated % Fiber Coverage in Max Fiber Scenario December 2022 vs. June 2023 Data



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

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