

BEAD Threshold Financial Model

Overview and Demonstration

August 30, 2023

Contents

1 | Introduction

2 | Model Overview

3 | Demonstration

Extremely High Cost Threshold Model

FBA and Cartesian have partnered to develop a model that evaluates the impact of the Extremely High Cost per Location Threshold (“Threshold”) to help states determine, consistent with the NOFO, how to maximize fiber deployments while covering unserved and underserved locations using BEAD and private funding.

Our model illustrates how funding could be allocated and how many locations would likely be served given a particular Threshold and several other constraints.

Objective

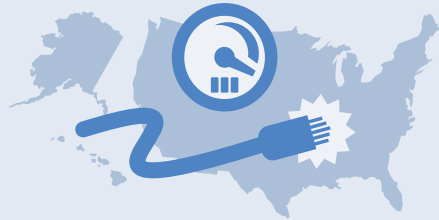


Modeling Approach

The model is informed by Cartesian’s theoretical fiber route model and several financing and deployment cost inputs, but core to setting the threshold is the state’s compliance with the NOFO and its desired goal for how to allocate funding.

As such, this model is a tool designed to help states understand the Threshold and weigh different potential thresholds as a policy lever that helps them deliver broadband to their most in-need locations.

What is the BEAD Program seeking to achieve?



The provision of robust, reliable broadband service to all unserved and underserved locations in all States and Territories by “prioritizing fiber connectivity directly to the end user”¹

What is the rationale for the BEAD Program prioritizing fiber connectivity?



“fiber-optic technology...will ensure that the network...can easily scale speeds over time to meet the evolving connectivity needs of households and businesses and support the deployment of 5G, successor wireless technologies, and other advanced services”²

Extremely High Cost Per Location Threshold | Definition & Purpose

What is the Extremely High Cost Per Location Threshold?



The BEAD Program’s Notice of Funding Opportunity (“NOFO”) defines the Threshold as:

“a BEAD subsidy cost per location... above which an Eligible Entity may decline to select a proposal [all-fiber project] if use of an alternative technology meeting BEAD’s technical requirements would be less expensive”

- ▶ In essence, the Threshold provides a level at which a State or Territory need not prioritize fiber deployments and instead may consider whether other technologies provide an efficient means to reach the highest-cost locations
- ▶ The Threshold is the key mechanism that States/Territories will use to achieve maximum fiber deployment while ensuring as many unserved and underserved locations as possible receive robust, reliable broadband service

Extremely High Cost Per Location Threshold | NOFO Directives

A

States/Territories need to submit a proposal to NTIA on setting their Threshold



- States/Territories (Eligible Entities) must submit a proposal on setting the Threshold when filing their **Initial Proposals** to NTIA
- The proposal can either **identify a Threshold**, or give a **detailed process** for doing so
- Each Entity is **expected to develop its own** reasonable Threshold

B

The Threshold needs to be as high as possible



- NTIA expects the Threshold to be **as high as possible** to ensure that eligible locations are not left behind and will receive the same fiber connectivity – **the most capable, reliable, durable last-mile technology** – that the most well-served U.S. locations receive
- For locations where the cost is above the threshold, States/Territories may consider, in addition to fiber options, selecting the **next best available technology**

C

The Threshold affects Broadband Service Provider participation¹



- Barring special circumstances in high-cost areas, providers must contribute **at least 25% of project costs**
- The Threshold dictates the maximum amount a State/Territory can contribute per location, which in turn **affects ISPs' willingness to participate in financing construction to the higher-cost locations**

¹ Full or partial contribution waivers can be granted by the Assistant Secretary on a case-by-case basis, but no specific detail is provided on how waiver requests will be assessed or how often they will be given

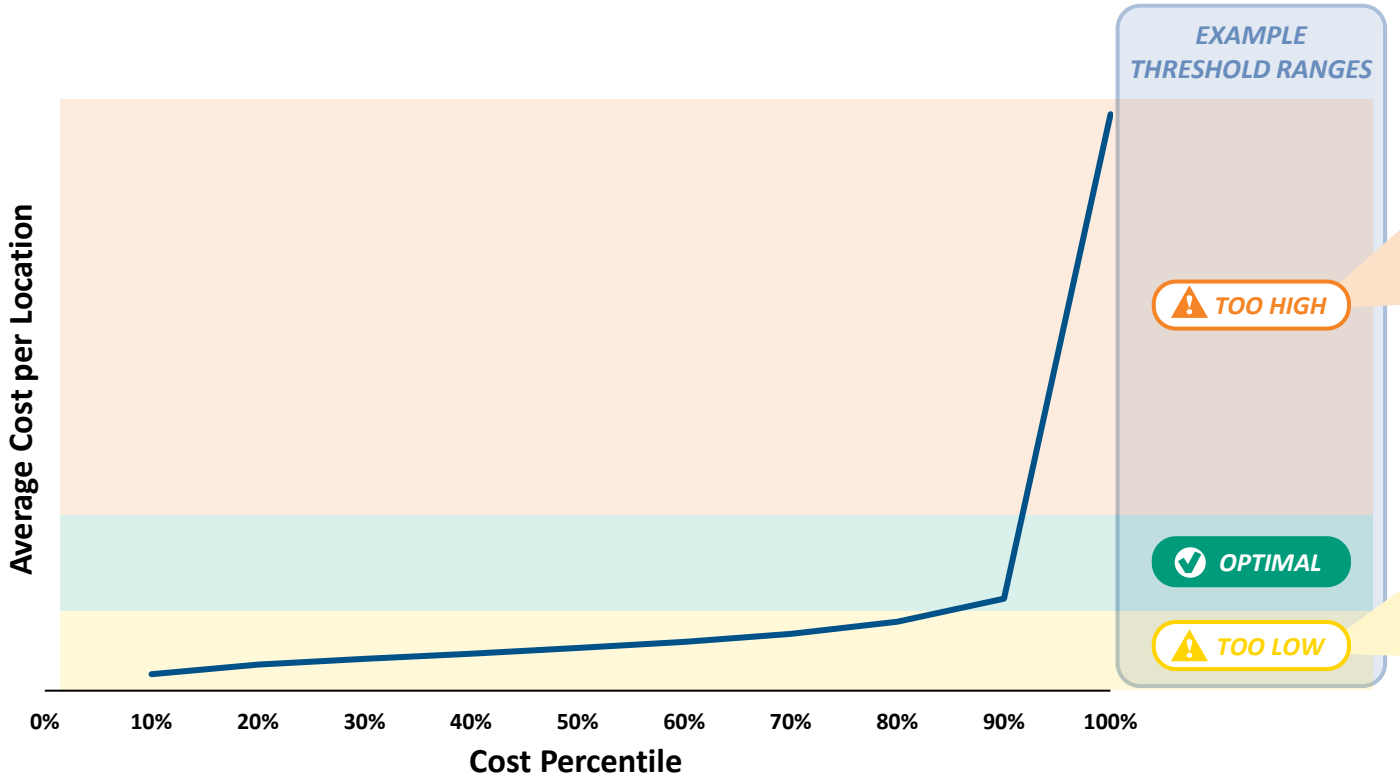
Source: Cartesian, NTIA BEAD Notice of Funding (NOFO)

Confidential and Proprietary — Copyright © 2023 Cartesian, Inc. All rights reserved.

Setting An Economically Rational Threshold | Weighing the Risks

The Threshold should be set to encourage deployment of fiber over less capable alternatives while not deterring providers from participating to build to all eligible locations – a fine line to tread

Fiber Deployment Cost per Unserved Location by Percentile¹



Risks that States/Territories may face:

! THRESHOLD IS SET TOO HIGH

LACK OF BIDS OR FUNDS
Eligible locations may completely miss out on getting access through BEAD funding

Many Locations suffer:

- Left with no broadband access, especially costly locations
- Stuck with poor connectivity options

! THRESHOLD IS SET TOO LOW

MISSED FIBER COVERAGE
Eligible locations that would have otherwise received fiber miss out

Affordable locations:

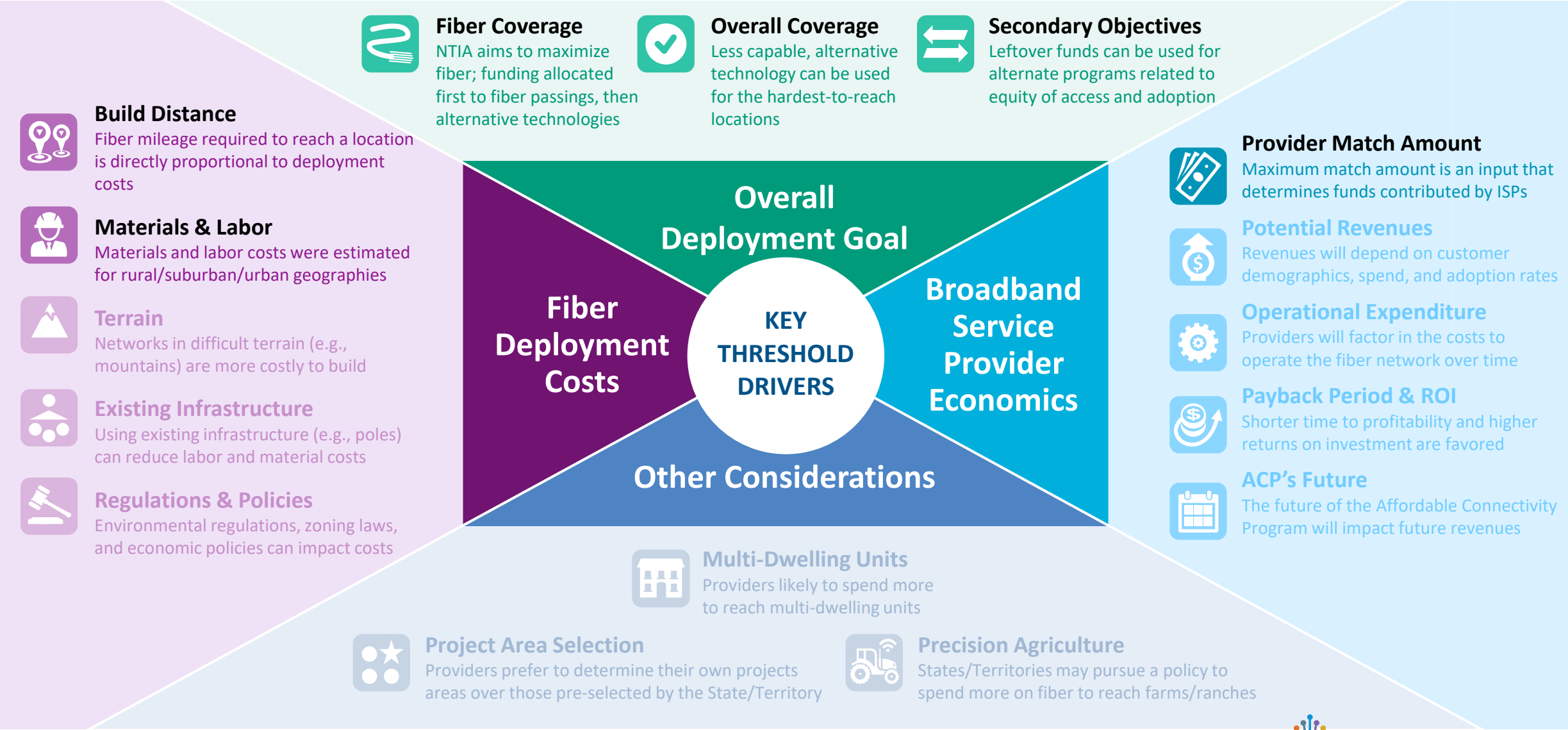
- Receive less capable technology
- Require more frequent upgrades
- Incur higher long-term costs

! The Threshold signals to providers where they should bid to provide fiber rather than less capable technologies

1. Chart is an example and reflects the typical “hockey-stick” distribution of the average deployment costs to reach unserved and underserved locations
 Source: Cartesian
 Confidential and Proprietary — Copyright © 2023 Cartesian, Inc. All rights reserved.

Model | Key Factors Considered

Many factors that set the Threshold are addressed by the model; others must be considered by the user



Contents



1 | Introduction

2 | Model Overview

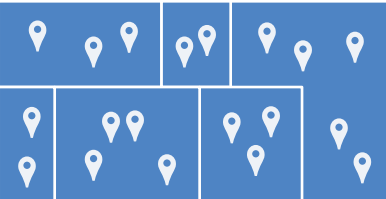
3 | Demonstration

Model Overview | Eligible Locations

The model uses the latest FCC Data Map counts of unserved and underserved locations with calculations performed at the census-block level

Unserved Locations	Underserved Locations
 <div style="display: inline-block; border: 1px solid #00A0C0; border-radius: 15px; padding: 5px; background-color: #00A0C0; color: white; font-weight: bold; font-size: 24px; margin: 10px 0;">4.7M</div> <i>Locations considered</i>	 <div style="display: inline-block; border: 1px solid #8E7CC3; border-radius: 15px; padding: 5px; background-color: #8E7CC3; color: white; font-weight: bold; font-size: 24px; margin: 10px 0;">2.4M</div> <i>Locations considered</i>
<p>Unserved locations have internet speeds below 25/3 Mbps</p>	<p>Underserved locations have internet speeds above 25/3 Mbps but below 100/20 Mbps</p>

Census Block



EXAMPLE

The model operates at the level of individual census blocks to calculate BEAD project costs and coverage. In practice, states may use other project boundaries.



Excluded Locations Funded by Other Programs	
Rural Digital Opportunity Fund	<i>3.4M locations</i>
Connect American Fund (CAF)	<i>393K locations</i>
Tribal Broadband Connectivity Program	<i>93K locations</i>
Other Federal Programs ¹	<i>2.1M locations</i>

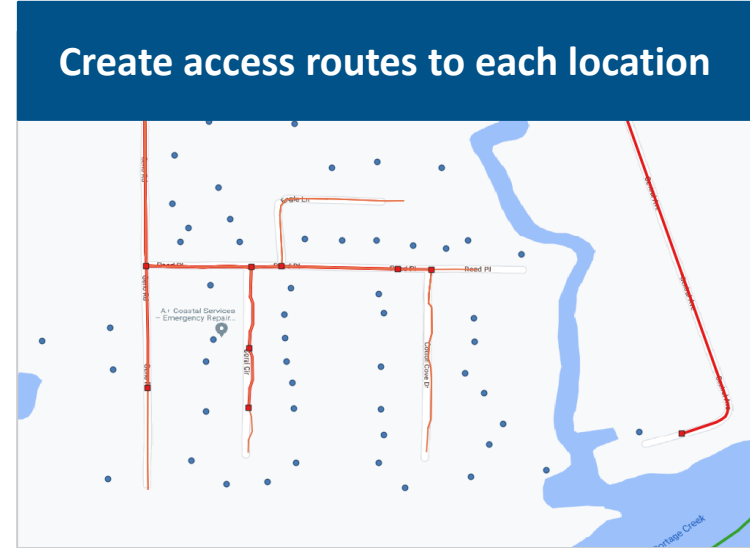
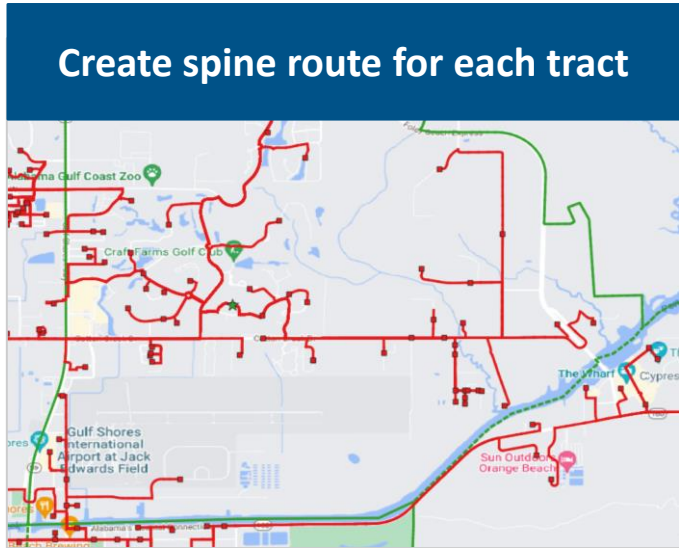
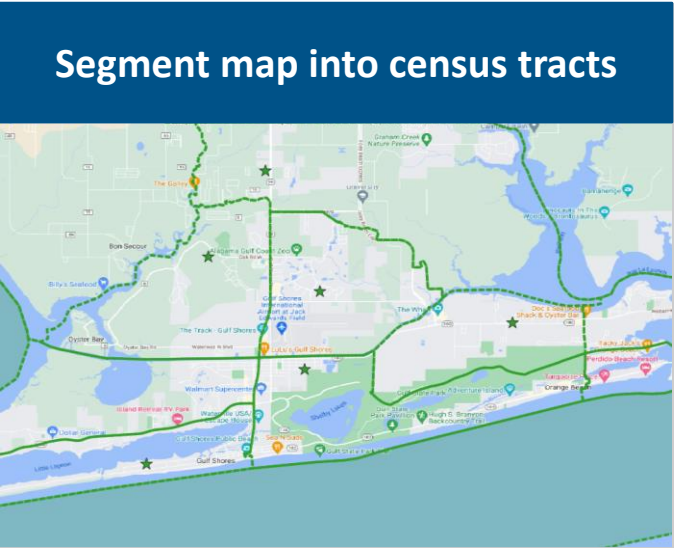
Census blocks provide a good level of granularity for analyzing the EHCT for all 50 states while keeping the model size manageable

1. Other federal programs modeled include the Broadband Infrastructure Program, the Rural EConnectivity Program, the Telephone Loan Program, and the Capital Projects Fund. Locations served by ARPA or ACAM funding are included in this analysis.
 Source: Cartesian, FCC Broadband Funding Map Funding Summary
 Confidential and Proprietary — Copyright © 2023 Cartesian, Inc. All rights reserved.

Model Overview | Fiber Routing Model

Fiber routing lengths are determined using open mapping data

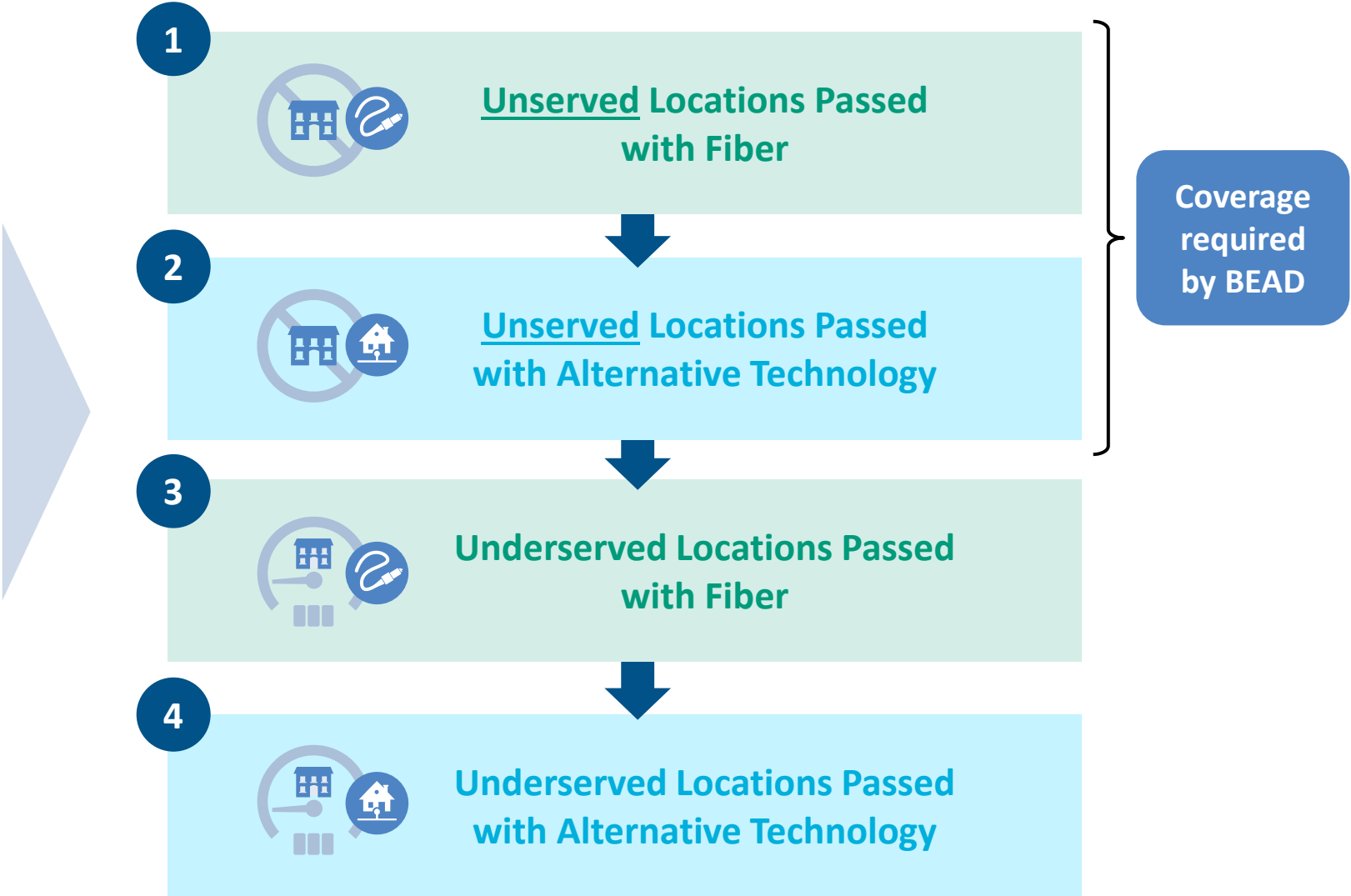
 Fiber Routing	 Average Mileage per Location
<ul style="list-style-type: none">▶ Our fiber routing uses an open dataset of US locations▶ Each structure in the data is marked with a point at its center, and access routes are drawn from each location to the nearest road▶ Spine routes are estimated for each census tract and then allocated proportionally to the census blocks in each tract▶ Access and spine fiber mileage are summed, resulting in a fiber mileage metric per census block	<ul style="list-style-type: none">▶ Fiber mileage and BEAD eligible location counts are aggregated by Census Block▶ Fiber mileage is then assigned proportionally to each location▶ Fiber miles are converted to cost estimates, and locations can then be sorted from least expensive to most expensive



Model Overview | Funding Allocation

The model allocates funds in line with the BEAD requirements – prioritizing unserved locations and fiber

- BEAD Funding
- Match Funding
- Eligible Locations
- Deployment Costs





Source: Cartesian
Confidential and Proprietary — Copyright © 2023 Cartesian, Inc. All rights reserved.


Model Overview | Cost Curves for Each State

For each state, the model ranks the census blocks to determine how far funding will go to closing the gap; average fiber mileage per location is used here as a proxy for location cost

Census Block Ranking Methodology

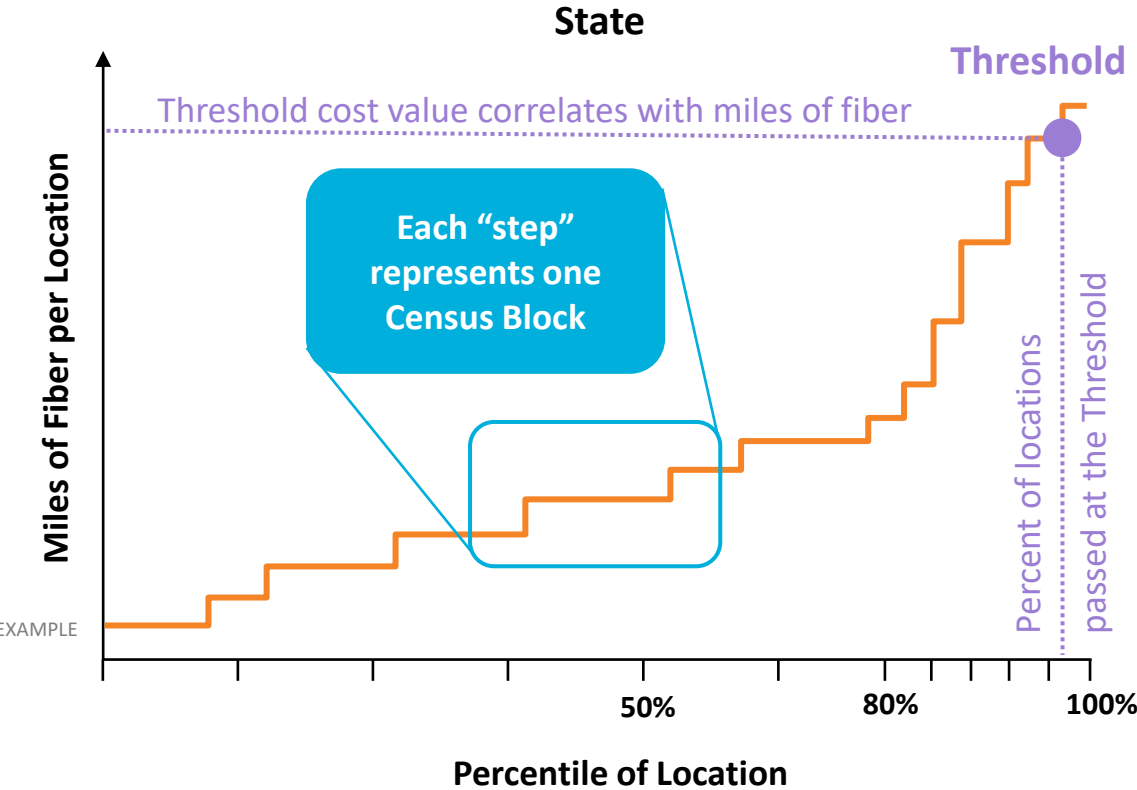
A  *Census blocks are sorted from low to high based on the average fiber mileage required per location*

B  *The share of a state's **unserved and underserved locations** is calculated for each block as a percentile*

C  *Sorting is done twice – first for unserved, then underserved – to enable prioritization of unserved*

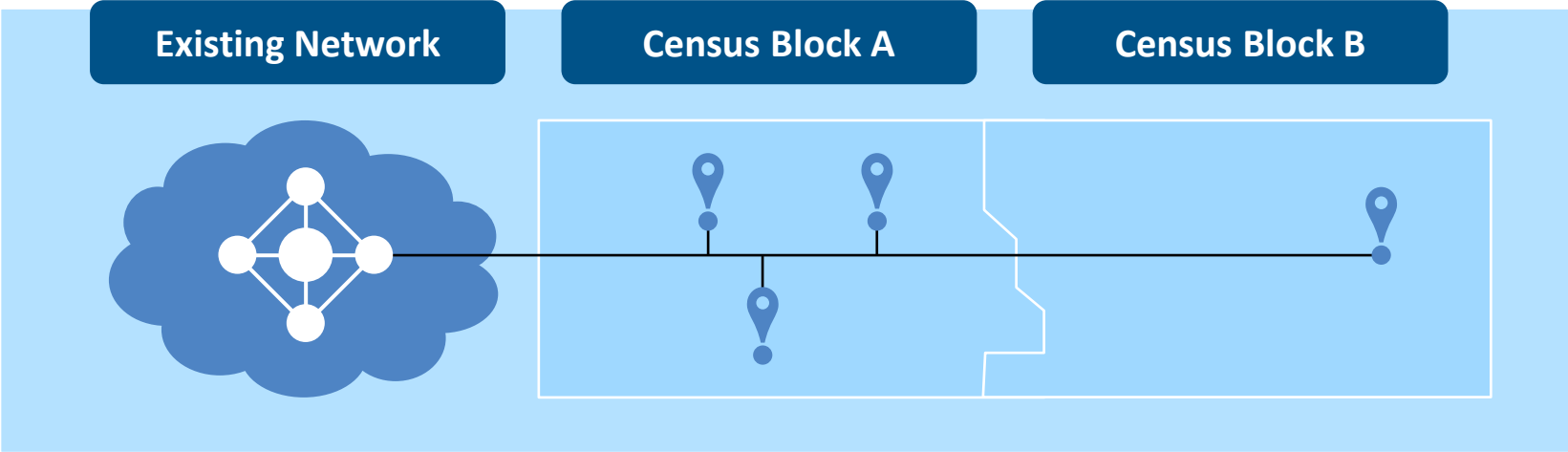
Illustrative Cost Curve

— Average Miles per Location



Model Overview | Average Costs vs. Highest Costs

The EHCT is a boundary for the most expensive locations, however ISPs will evaluate average location costs to determine their match; the model considers both factors in finding the optimum threshold value



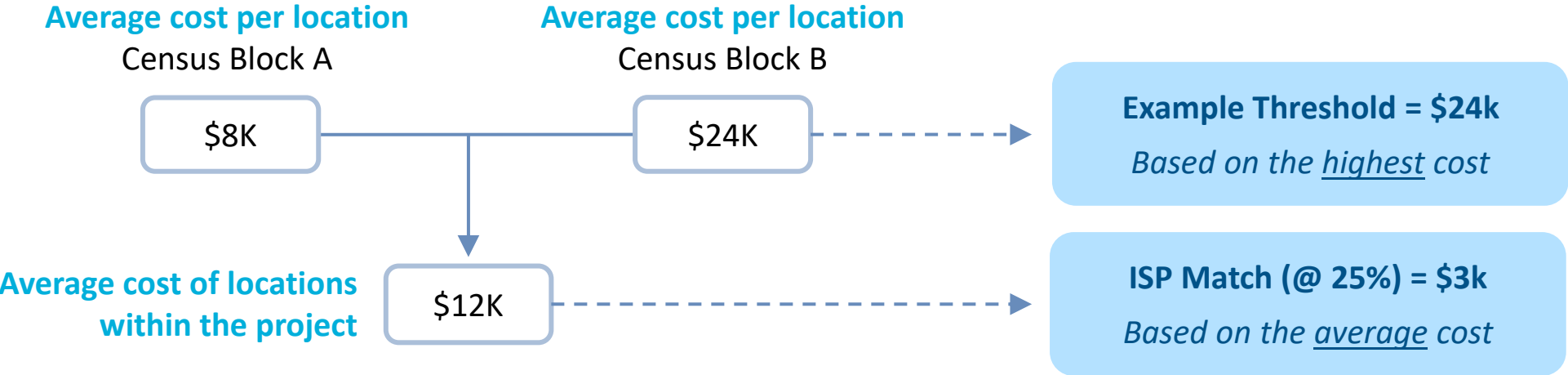
Example project area with two census blocks

Census Block A:

- Clustered locations
- Close to existing network

Census Block B:

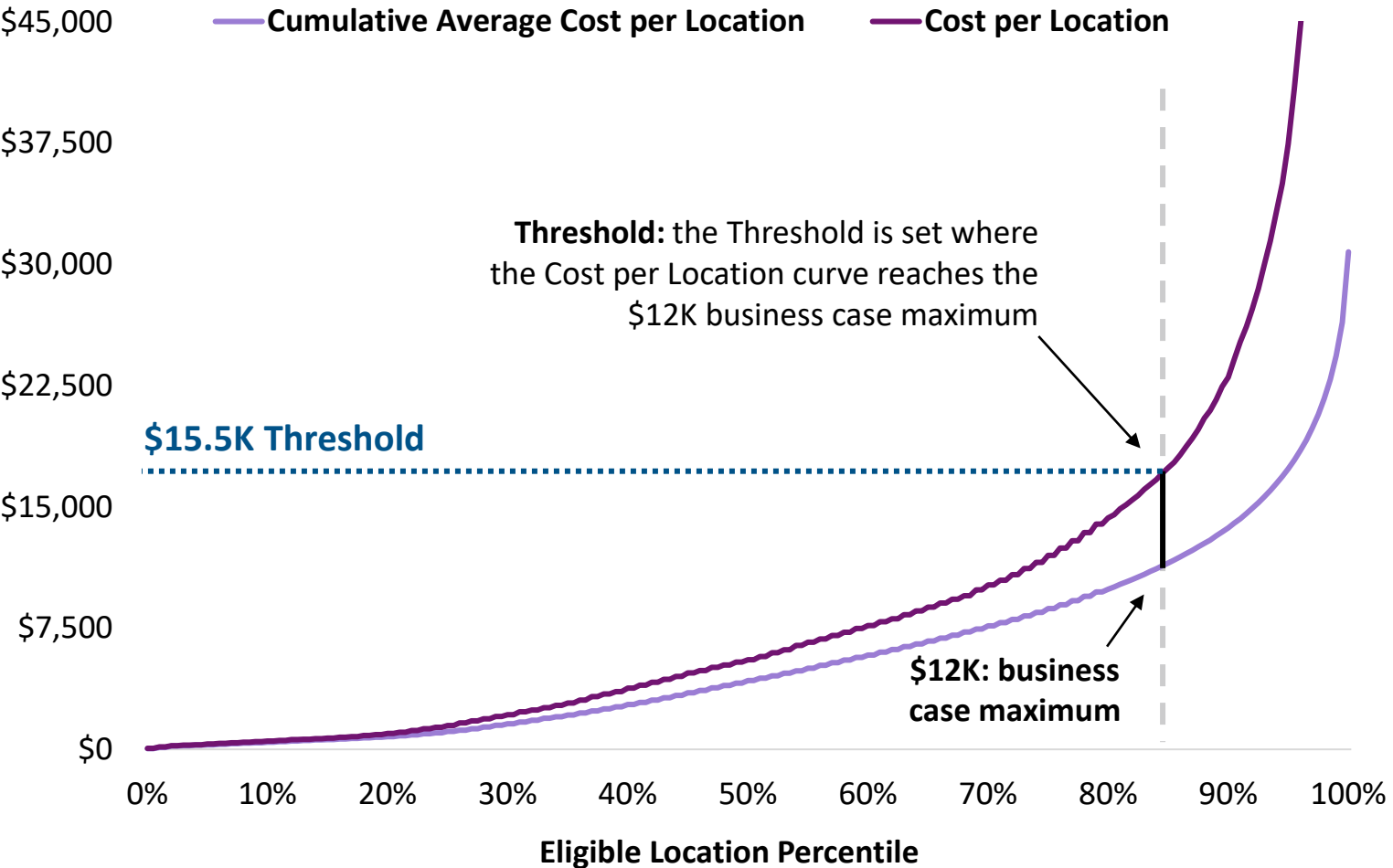
- Few locations
- Far from existing network



Model Overview | Average Costs vs. Highest Costs Example

Due to averaging of costs within a project, the threshold value is above the max value of the ISP business case

Visualizing the Threshold



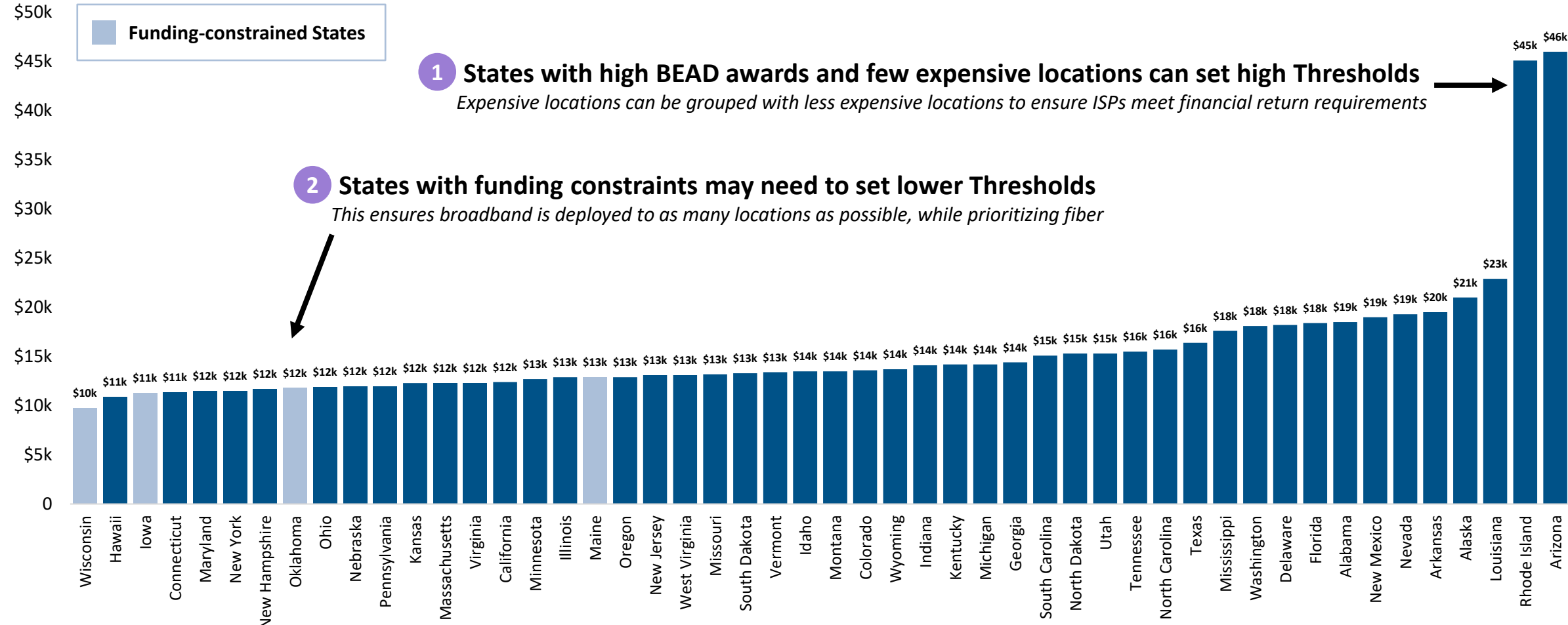
The **Cost Per Location** curve is the cost to pass locations at a given percentile. This value informs the threshold.

Cumulative Average Cost is a running average of the Cost Per Location. This value is used to evaluate the business case for the ISP match.

We expect projects to consists of locations with similar costs. To model this, the running average only considers the top 25% of locations by cost at any given point.

Model Overview | Thresholds by State

Under default model inputs, optimal Thresholds are between \$10k and \$20k for most states






1 States with high BEAD awards and few expensive locations can set high Thresholds
Expensive locations can be grouped with less expensive locations to ensure ISPs meet financial return requirements

2 States with funding constraints may need to set lower Thresholds
This ensures broadband is deployed to as many locations as possible, while prioritizing fiber

These Thresholds are optimized to provide maximum broadband deployment to both unserved and underserved locations, which meets NOFO requirements. They are a benchmark for states looking to determine their own Threshold.

Model Overview | Default Inputs

Provider match, alternative technology costs, and build cost default inputs can be adjusted by the end user

Input	Model Default	Rationale
 <p>Provider Match</p>	<p>Max ISP Match (%): 75%</p> <p>Max ISP Match (\$): \$3.0K</p>	<ul style="list-style-type: none"> The highest provider match dollar amount is an estimate of the maximum an ISP would spend to deploy fiber while meeting financial return requirements
 <p>Alternative Technology Cost</p>	<p>Cost per Passing: \$4.8K</p> <p>Provider Match (%): 40%</p>	<ul style="list-style-type: none"> \$4.8K cost per passing is based on benchmark costs for fixed wireless While fixed wireless can be slower and less reliable than fiber, it will likely be the most common alternative technology for locations above the Threshold
 <p>Fiber Cost Benchmarks</p>	<p>Blended deployment costs for each morphology</p>	<ul style="list-style-type: none"> The model's deployment cost estimates are set at a national scale Aerial, buried, and underground deployment cost benchmarks are blended for each morphology (rural, suburban, and urban)

Model Overview | Important Points

When using the published model, please keep the following important points in mind

Location Data



The published model uses fiber route lengths calculated by Cartesian using **open mapping data**. Locations in that data may vary from the FCC Data Map fabric, which is not publicly available. The model does not consider the **location of existing ISP infrastructure** that may be leveraged for BEAD.

Build Costs



The default cost inputs in the model are **benchmark values** calculated by Cartesian from a range of sources. In practice these will vary between, and within, individual states. **Costs can be customized** to reflect local terrain, preferred deployment types, and regional labor costs for additional precision.

State Funding



The published model does not directly consider **state-level broadband funding programs**. These could be added into the model to complement the federal funding programs already accounted for to prevent the “double funding” of locations.

Project Boundaries



Project boundaries are **not currently known**. The model assumes projects will contain locations with a mix of cost profiles. In setting the Threshold, the model takes a **conservative stance** by assuming a mix of locations above state-wide average costs are included in projects.

Contents

1 | Introduction

2 | Model Overview

3 | Demonstration



www.fiberbroadband.org



www.cartesian.com

MARISSA MITROVICH
VP OF PUBLIC POLICY
FIBER BROADBAND ASSOCIATION
MMITROVICH@FIBERBROADBAND.ORG

MICHAEL DARGUE
VICE PRESIDENT
CARTESIAN
MICHAEL.DARGUE@CARTESIAN.COM

SAMUEL KORNSTEIN
MANAGING DIRECTOR
CARTESIAN
SAMUEL.KORNSTEIN@CARTESIAN.COM