Fiber Deployment Cost Annual Report

2024

Fiber Broadband Association

Cartesian®

When fiber leads, the future follows.

EXECUTIVE SUMMARY

The Fiber Broadband Association has partnered with Cartesian to research the cost of deploying fiber and provide insight on how these costs are evolving over time.

In preparing this second edition of the Fiber Deployment Cost report, Cartesian gathered inputs from a wide variety of firms building fiber networks across the nation. Research was conducted via phone interviews and online surveys in October and November 2024. Participants included network operators and contractors, with projects distributed across 32 individual states.

Selected highlights in this year's study are presented below.

Underground deployments are most common despite being more expensive than aerial

Within the survey sample, 40% of respondents exclusively deployed fiber via underground deployments versus 16% who exclusively used aerial. Typical costs ranged from $10 to $27 per foot for underground deployments, compared to $5 to $14 for aerial deployments.

Labor is the primary component for deployment costs

The share of deployment costs attributable to labor costs range from 60 – 80%. The median labor cost for underground deployment was $13/foot versus $4/foot for aerial. Reported costs for internal labor were half those of outsourced labor.

Deployment cost varies widely with construction technique

For underground builds, plowing had the lowest reported median cost of $14.50/foot while trenching had the highest at $26.50/foot. For aerial deployments, participants reported similar costs for Strand and Lash versus ADSS cabling methods, at $6.75/foot and $6.55/foot, respectively.

Firms that own poles reported lower costs for aerial deployments than those seeking access

The median cost of aerial build among firms that have their own poles was $4.90/foot, compared to $7.00/foot for those firms renting poles from others.

Permits and make ready costs are key factors on everyone's mind

Respondents noted longer delays obtaining permits for fiber builds, impacting overall project costs and timelines. For poles, respondents also noted that make ready costs and attachment fees have increased.

Expected cost increases for 2025 are predicted to be lower than 2024

While this year saw deployment costs increase compared to last year, the expectation going into 2025 is that this may cool down slightly. 25% of respondents expect a cost increase of greater than 10% to occur in 2025, compared to 41% of respondents who experienced such an increase in 2024.

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INTRODUCTION

More than half of all households in the US—nearly 76.5M unique households—are serviceable by fiber today. This impressive achievement has been reached thanks to the combined efforts of the nation's broadband providers and their suppliers.

In the last 6 years, fiber coverage in the US has more than doubled. Yet, there is still much more to come. Fiber coverage is set to grow to 80% over the next few years, bringing the benefits of fiber broadband to many more homes and businesses.

Given the scale of investment in fiber, it's essential to understand the current state of fiber, the costs associated with deploying, and how the fiber landscape is likely to change going forward.

To bridge this gap, the Fiber Broadband Association has partnered with Cartesian to research the cost of fiber deployment and provide insight on how costs are evolving over time. The first edition of the report gathered data from deployments in 2023.

Since the publication of the 2023 report, many factors impacting the fiber landscape have changed. The economic climate has improved, supply chain disruptions have abated, and the National Telecommunications and Information Administration (NTIA) has now approved all the Initial Proposals for the Broadband Equity, Access, and Deployment (BEAD) program. Several high-profile M&A deals were announced, with ILEC's leading the charge in acquisition of smaller players.

In this report, we summarize the fiber deployment landscape in 2024, presenting our findings from the 2024 Fiber Deployment Cost Survey, and look ahead to 2025 and beyond for developments in the industry.

Section 1 looks at this past year for fiber deployment through deployment numbers, trends, industry news, and BEAD updates.

Section 2 provides an overview of the factors that impact fiber deployment costs and detailed findings from this year's Fiber Deployment Cost Study.

Section 3 reviews cost trends based on findings from this year's Fiber Deployment Cost Study and summarizes expectations for the coming year.

SECTION 1: FIBER YEAR IN REVIEW

57% of homes in the US are now serviceable by fiber

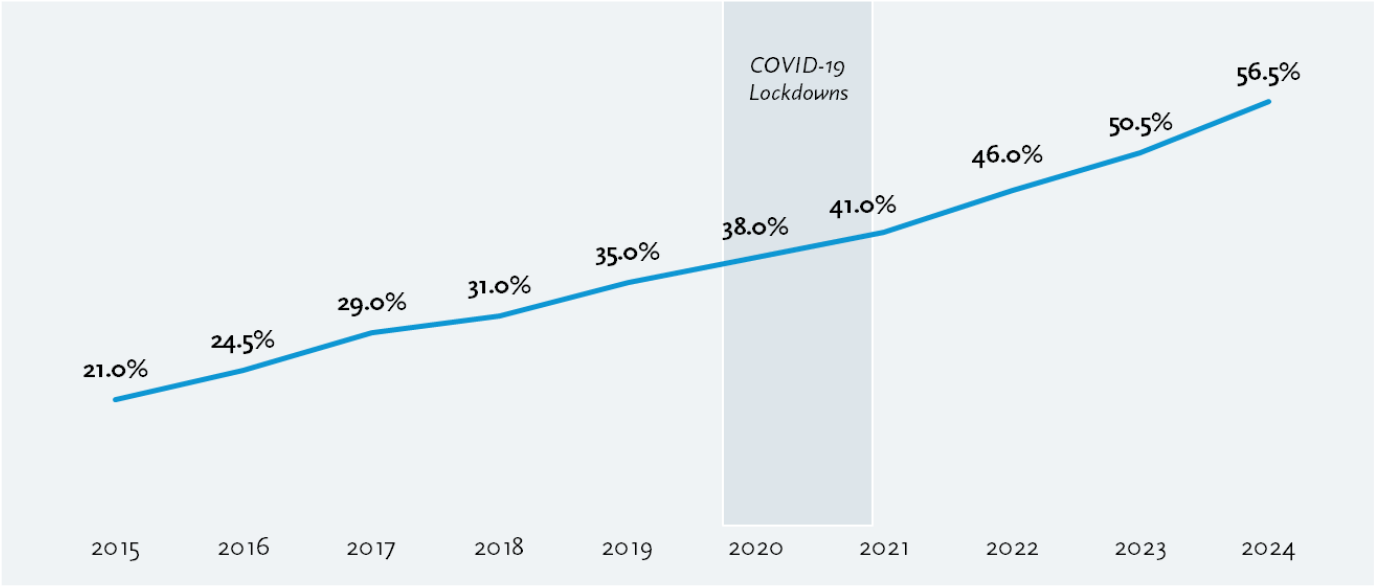
The momentum for fiber deployment in the US has continued, with another strong year for fiber rollouts.

According to a recent study by the Fiber Broadband Association and RVA, 76.5M US homes (56.5%) are now passed by fiber[1]. This is thanks to a record-breaking year of new fiber passings, at 8.4M new homes—13% growth— in 2024.

Fig 1.1

Fiber Access in the US by Share of Households (2015 – 2024)

% of Passings Serviceable by Fiber



Source: The State of the North American Fiber Deployment 2024 – Fiber Broadband Association, RVA LLC

Even though over half the US is now serviceable by fiber, fiber deployment isn't going to slow down anytime soon. The next few years will see fiber in more and more communities, with fiber expected to reach 80%[2] of US households by 2028. Current and projected growth is on track with Fiber Broadband Association's goal for fiber to reach 90% of US homes by 2030.

Private capital pushes fiber deployments to new heights

The gains in fiber coverage were achieved despite economic pressure from interest rates and inflation. Although rates have fallen, they have yet to return to the long-term average.

The willingness to invest in this economic climate reflects the confidence in fiber broadband as an enduring, long-term asset. Service providers – and their financial backers – recognize that fiber infrastructure is the infrastructure of choice for reliable high-speed broadband. Investments today will generate returns for years to come.

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1 Fiber Broadband Association, RVA LLC joint study – data as of September 2024; passings represents homes with at least one fiber service marketed

2 UBS US Telecoms Report 2024

Footprint expansion this year has not only been achieved through organic growth, but also through several high-profile deals, such as Verizon's proposed acquisition of Frontier. Once cleared, this deal will add 10M homes to Verizon's total with potential for another 2M through synergies.

Other notable announcements include the re-merger of Uniti and Windstream, T-Mobile joining forces with KKR to buy Metronet, and Bell Canada's acquisition of Ziply Fiber.

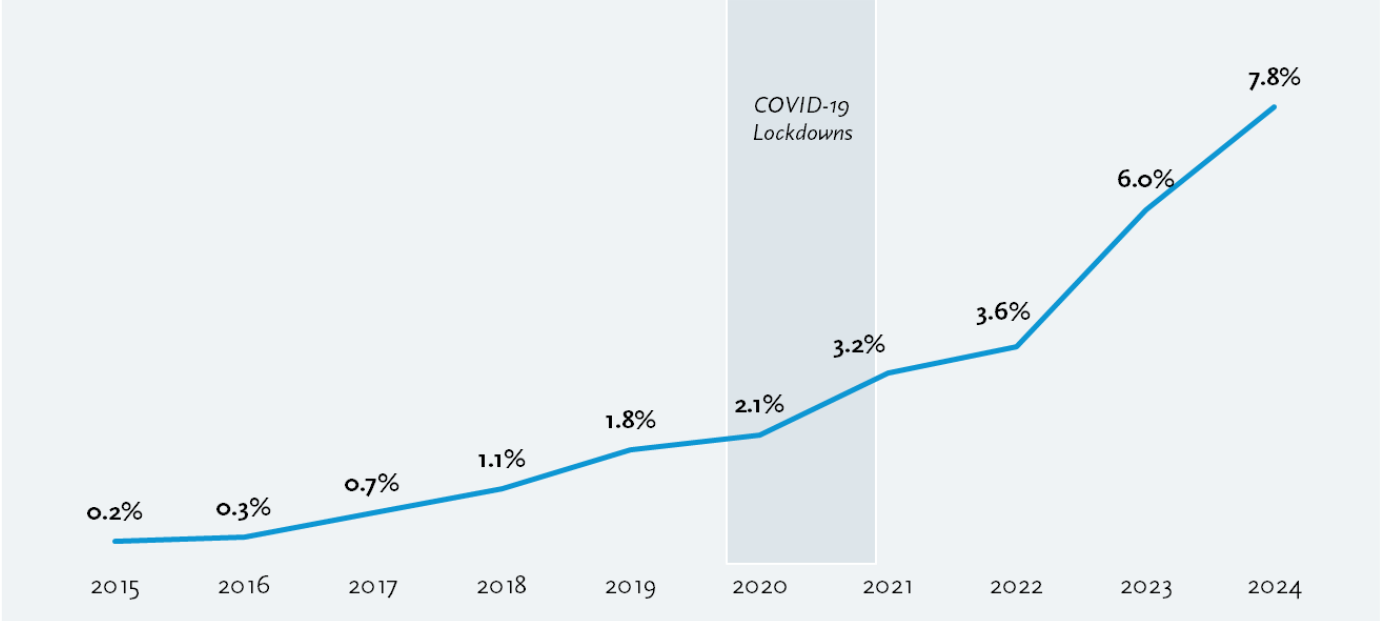
More US locations have a choice of fiber network

The ongoing investment in fiber broadband is bringing more choice to US consumers. As of June 2024, 7.8% of locations are now serviceable by at least two fiber providers: an increase of roughly 2M additional locations over the previous year[3].

As shown below, the growth in fiber competition has stepped up in recent years, following limited activity over most of the past decade. The growth is being led by overbuilders (i.e., providers that overbuild legacy networks). In turn, this competitive presence is leading incumbents to upgrade their HFC or DSL networks with fiber.

Fig 1.2 **Fiber Access in the US by Share of Locations with 2+ Fiber Providers (2015 – 2024)**

% of Locations Serviceable by 2+ Fiber Providers



Note: FCC Form 477 data utilized for June 2015 to June 2021, and FCC Broadband Data Maps used for June 2022 and beyond
Source: FCC Form 477 and Broadband Data Collection (BDC) filings, June 2024 release, accessed November 2024

Fiber growth is driven by a variety of providers

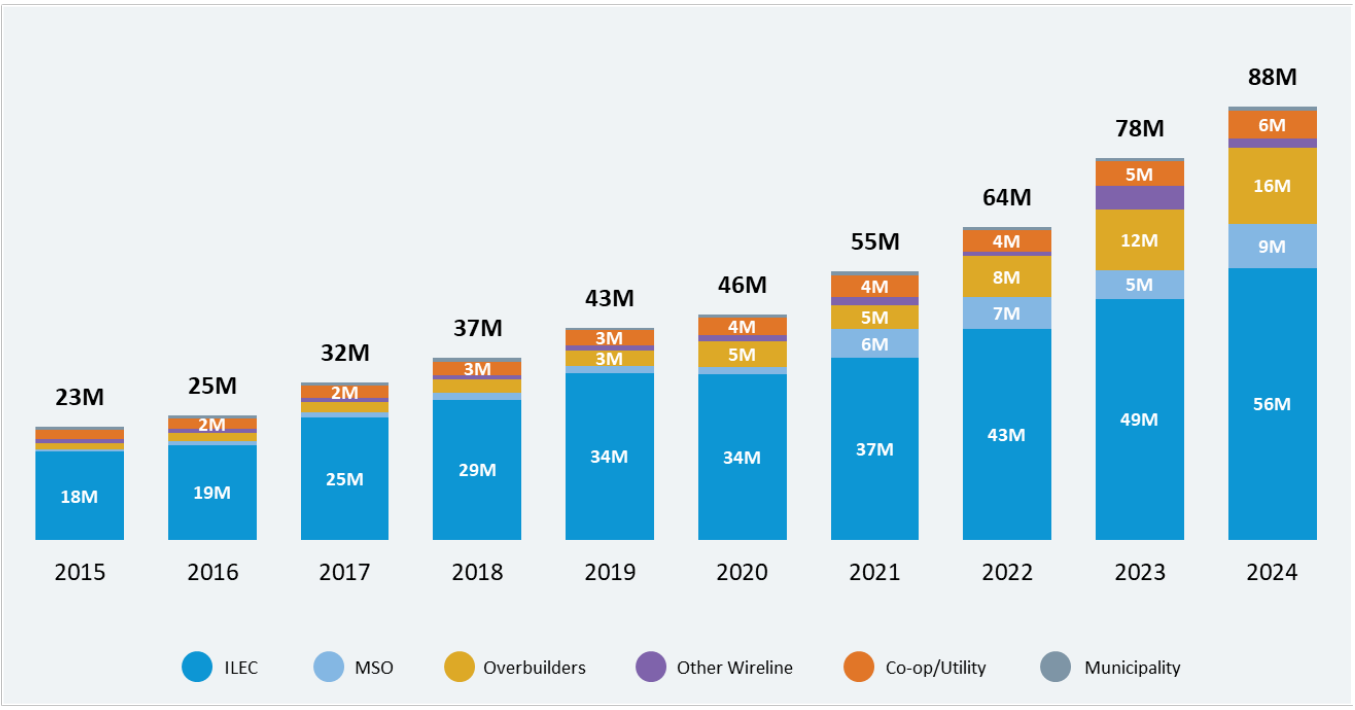
A notable aspect of fiber expansion in the US is that a variety of operators are getting in on fiber. While the majority of passings have been built out by ILECs, other types of providers have increased their share over time.

[3] Note the FCC Broadband Data Map does not separately count individual units within multi-dwelling units (MDUs). A single location in the FCC map could be an MDU containing 10 units or more. Hence the serviceability of locations and housing units are not directly comparable.

Fig 1.3

Fiber Deployments by Provider Type (2015 – 2024)

Total Fiber Passings[1]



Note: Cartesian estimates based on data from FCC Form 477, FCC Broadband Data Map, and Census Bureau data
1: Includes double passings
Source: FCC Form 477 and Broadband Data Collection (BDC) filings, June 2024 release, accessed November 2024, Census Bureau

ILECS have demonstrated consistent YoY growth ranging between 10 – 15% since 2020. With increasing M&A activity and consolidation of smaller fiber players, ILECs are likely to make further gains across the US.

However, it is overbuilders who have advanced their fiber coverage the most since the pandemic, with fiber coverage doubling from 8M passings in 2022 to 16M passings in 2024.

MSOs are also ramping up their fiber deployment, adding 4M passings over the past 12 months. Upgrading to – or expanding with – fiber enables MSOs to better compete with fiber overbuilders, while also futureproofing their networks and reducing operational costs. MSO fiber will also be boosted by BEAD, with cable operators expected to win 20 – 25% of BEAD funds, driven in part by their large presence in states such as California and Texas, which will receive the bulk of BEAD funds.

Finally, electric cooperatives and municipalities are also making gains in fiber deployments. With approximately 7M passings currently served by co-ops or municipalities, this segment has rapidly grown since 2020, when it was close to 4M. These providers could stand to benefit greatly from BEAD, given their ownership of existing infrastructure.

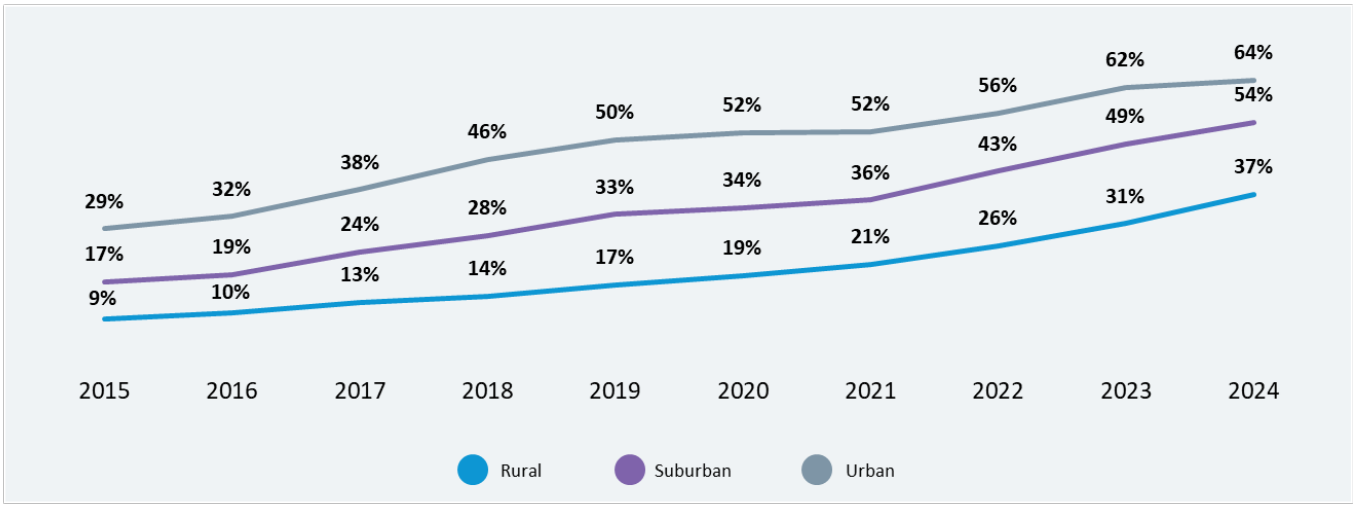
Rural coverage is making significant headway

As fiber deployments initially gained momentum, providers typically connected dense urban and suburban areas with fiber. However, with these markets close to reaching a steady state, focus has shifted to rural areas, with significant gains being made over the last 3 years.

Fig 1.4

Fiber Coverage by Population Density[1] (2015 – 2024)

Share of Total Locations with Fiber Access



Note: FCC Form 477 data utilized for June 2015 to June 2021, and FCC Broadband Data Maps used for June 2022 and beyond
1: Rural is <100 locations per square mile, suburban is 101 – 2500 locations per square mile, urban is 2500+ locations per square mile
Source: FCC Form 477 and Broadband Data Collection (BDC) filings, June 2024 release, accessed November 2024

As of June 2024, approximately 10.5M rural locations are now serviceable by fiber. This represents a YoY gain of 1.8M locations from June 2023.

The increase in rural coverage has been aided by a variety of state and federal government programs to support investment in rural fiber. With BEAD funding set to reach providers in 2026, we expect to see considerable growth here in the coming years.

ILECs continue to rapidly expand fiber

2024 saw major ILECs such as AT&T and Verizon recalibrate their fiber targets, with AT&T increasing their long-term target from 31M homes passed by 2025, to 50M+ by 2029[4]. Similarly, Verizon has also announced an increase in their fiber target from 18M by 2025, to 35M – 40M in the next 10 years (including 10M homes from Frontier's acquisition)[5].

AT&T, which remains the largest player in the fiber market, has clearly indicated its long-term strategy is centered around fiber. In October 2024, AT&T announced a multi-year purchase agreement with Corning to support AT&T's fiber build, in a deal valued at over $1 billion. Additionally, AT&T and BlackRock announced an expansion of their JV Gigapower, signing new agreements with commercial open-access providers. This will allow AT&T to expand its fiber in greenfield areas, which previously had no fiber options.

Verizon meanwhile has signaled its intention to become the largest player in the fiber market. In September 2024, Verizon announced its plan to acquire Frontier in an all-cash transaction, valued at $20 billion. If the deal goes through, Verizon will amass ~30M homes passed by 2026. Post-acquisition, Verizon plans a yearly build of 1M homes passed until they reach 40M homes[6].

4 AT&T Analyst Day 2024 presentation
5 Verizon 3Q24 Results
6 Verizon 3Q24 earnings call

Major players are on track with their fiber rollouts

When it comes to progress in fiber deployment against individual targets, most large providers are on track. Among those we follow, 7 of 12 met or exceeded their announced fiber targets this year, with AT&T outpacing its target by nearly 75%[7].

Among the providers who are currently below their targets, Altice has signaled that their focus is to drive more penetration to their fiber network, while continuing to build fiber in urban areas. Meanwhile, in rural areas, their approach is to upgrade their entire footprint to DOCSIS 3.1[8], as of November 2024.

Other players such as Lumen and Breezeline indicated a general slowdown in their fiber build due to the economic climate in the US, but they anticipate that future build may accelerate. Finally, Consolidated Communications is currently attempting to raise private capital to maintain its build targets.

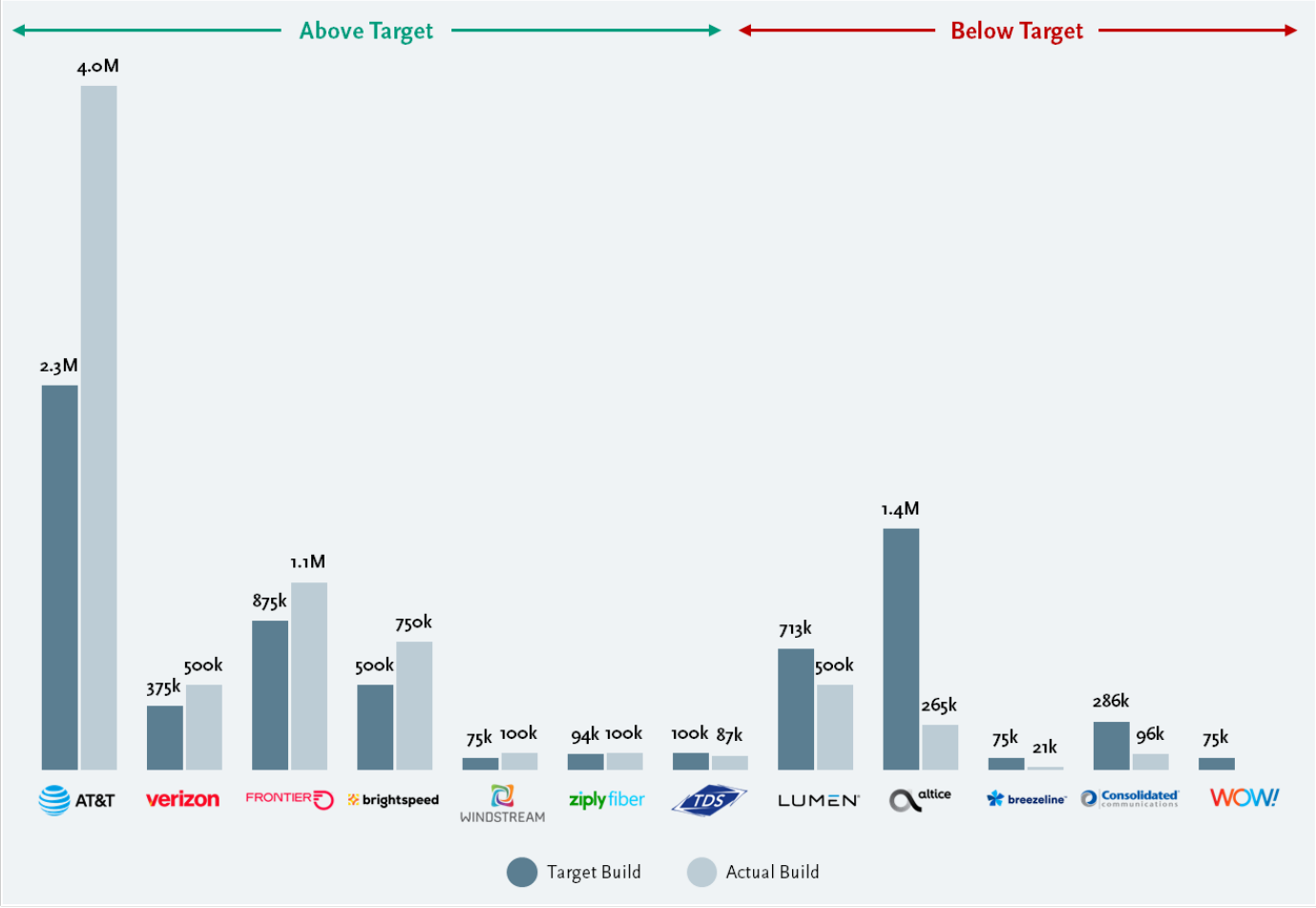
[7] TDS Telecom was slightly below its target pace; however, they announced that they are on-track towards their 2026 target.

[8] Altice, 3Q24 Results

Fig 1.5

Annualized Fiber Builds for Major Fiber Providers[1]

Target yearly build vs. Actual yearly build for 2024



1: Limited information available for WOW!'s current fiber passings
Source: Company press releases, public filings as of 12/2024

Every state and territory is now ready for BEAD

Significant progress was made this year in bringing the BEAD program closer to fruition.

To recap the process, states and territories are required to submit an Initial Proposal to the NTIA setting out how they plan to disburse their share of the $42.5B funds. Once this is approved, the entities then run a challenge process (to validate which locations are eligible for funding), and a subgrantee award process to select broadband service providers for funding. The individual projects then move into deployment mode with the service providers building out networks to reach the unserved and underserved locations.

As of this report's publication (December 2024), the NTIA has approved the initial proposals for all 56 eligible entities, 26 of which have already concluded the challenge process stage. Delaware, Louisiana and Nevada have completed provider selections, with their Final Proposals now being reviewed by the NTIA.

All three states' award processes show a clear preference for fiber. Louisiana awarded 95% of funds to fiber-to-the-home (FTTH) solutions[9], including 60% to a consortium of SwyftFiber, REV, and T-Mobile (providing 5G support). Conexon Connect secured ~9% of available funds, while AT&T received about 7.5%.

Nevada allocated more than 80% of its BEAD money to fiber, with more than half of the funding going to two fiber providers – SkyFiber Internet and Stimulus Technologies of Nevada[10]. Delaware has preliminarily selected Verizon and Comcast (via its Xfinity brand) to serve its BEAD-eligible locations with fiber[11].

[9] Per ConnectLA provisional awards announced on November 18, 2024

[10] Per Nevada Governor's OSIT provisional awards announced on December 16, 2024

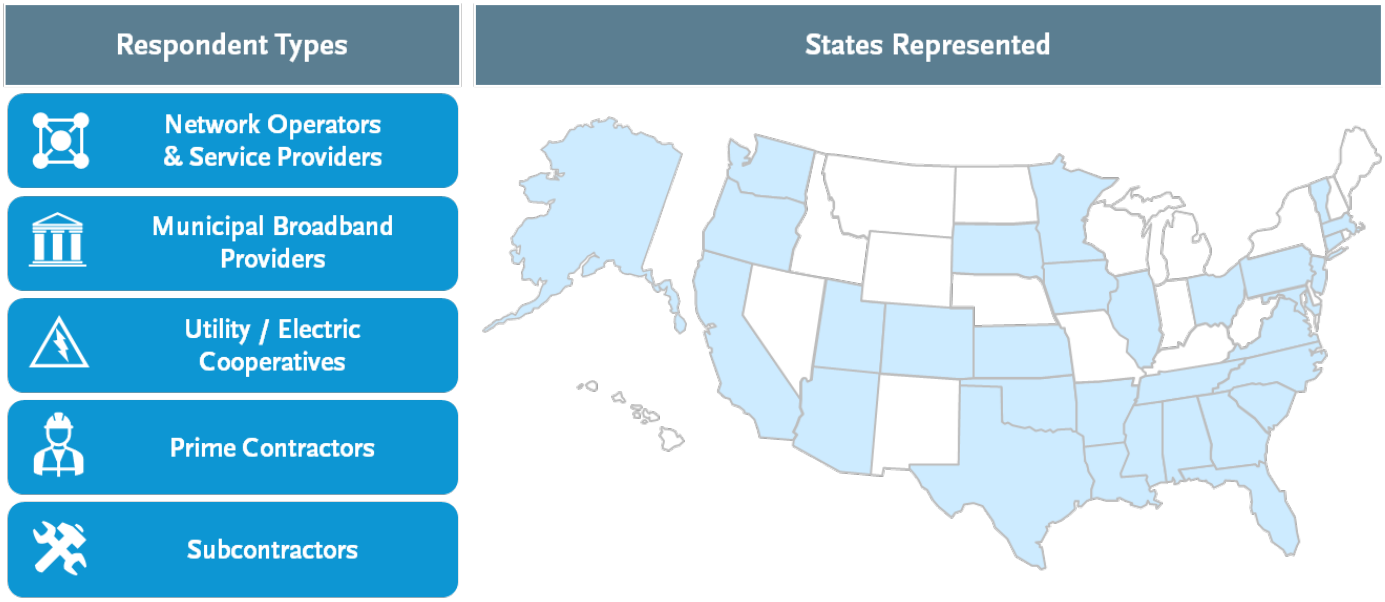
[11] Per Delaware Broadband Office provisional awards announced on December 11, 2024

SECTION 2: FIBER DEPLOYMENT COSTS

In this section we present the findings of our annual fiber deployment cost study. We explore how costs vary by type of build and how costs have evolved since last year's study[12].

The results are based on primary research with firms that deploy fiber, including service providers and contractors. Responses represent deployment projects across 32 states and a variety of build scenarios.

While we expect the results to reflect typical build costs, the costs reported by respondents in our study may not be representative of all fiber deployments.



Source: Fiber Broadband Association Fiber Deployment Cost Study 2024, Cartesian

The fiber deployment cost study encompasses a range of deployment scenarios

Many factors influence the cost of a fiber deployment, and no two projects are the same.

To enable meaningful comparison of responses, respondents were asked to report the costs for labor and materials on a unit cost basis (cost per foot). Additionally, we asked respondents to provide an estimated share of overall project cost attributable to permitting, engineering, and make ready costs.

As in last year's study, respondents were asked to characterize the deployment project they reported on to help contextualize the costs. Respondents provided input on the terrain, construction technique utilized, and housing density.

For this year, we also investigated the use of internal vs. outsourced labor, typical ownership of poles utilized in aerial deployments, and the use of Strand and Lash vs. All-Dielectric Self-Supporting (ADSS) cables.

[12] Note: Annual cost trends are based on respondents to the 2023 and 2024 studies answering questions on their current costs. The samples for the two studies are independent, hence care should be taken when interpreting the results.

Underground deployments are twice as expensive and more common than aerial builds

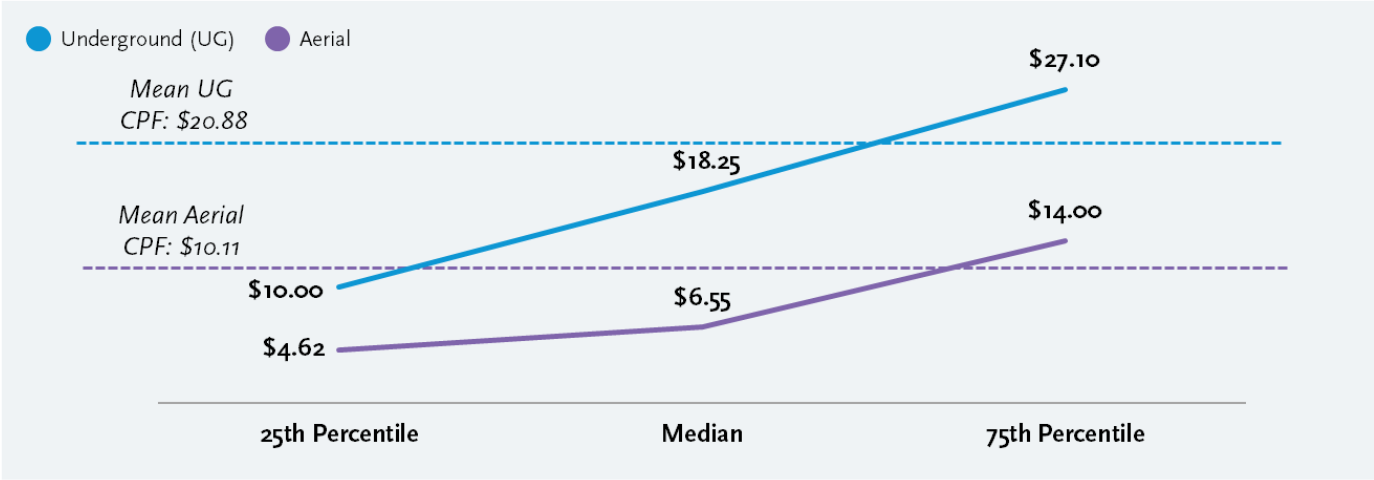
As in last year's study, we consider the costs of both aerial and underground deployment. In aerial deployment, fiber cables are run overhead on utility poles, whereas for underground deployment, the cables are placed in conduits and ducts.

Responses to the study show that underground construction is significantly more costly than aerial builds. The median reported cost for underground deployments was $18.25/ft versus $6.55/ft for aerial deployments. In both cases, there was a wide range of reported costs, hence we focus our analyses on median costs unless otherwise stated.

Fig 2.1

Deployment Cost Interquartile Ranges

Cost per Foot, Labor and Materials Only



Source: Fiber Broadband Association Fiber Deployment Cost Study 2024, Cartesian

A greater share of study respondents utilized underground deployment (over aerial) despite this method being more expensive. Underground methods were exclusively used by 40% of study respondents. Another 16% of respondents indicated they primarily use aerial deployment, while the remaining 44% use a combination of both methods.

Those that deploy primarily underground see it as being more resilient and better protected against environmental and accidental damage. In other words, the higher capex can reduce opex and lead to fewer unexpected network disruptions. In some cases, underground deployment may be easier in areas where negotiating pole access is cumbersome and/or expensive.

When poles are available, aerial deployments typically have the advantage of being quicker and requiring less work than underground methods. For entities that have their own poles, aerial deployments are relatively cheap and easy. For those that rent pole space, make ready costs can greatly impact overall costs. While not reflected in cost ranges above, some study participants reported make ready costs can contribute 15 – 20% of project costs.

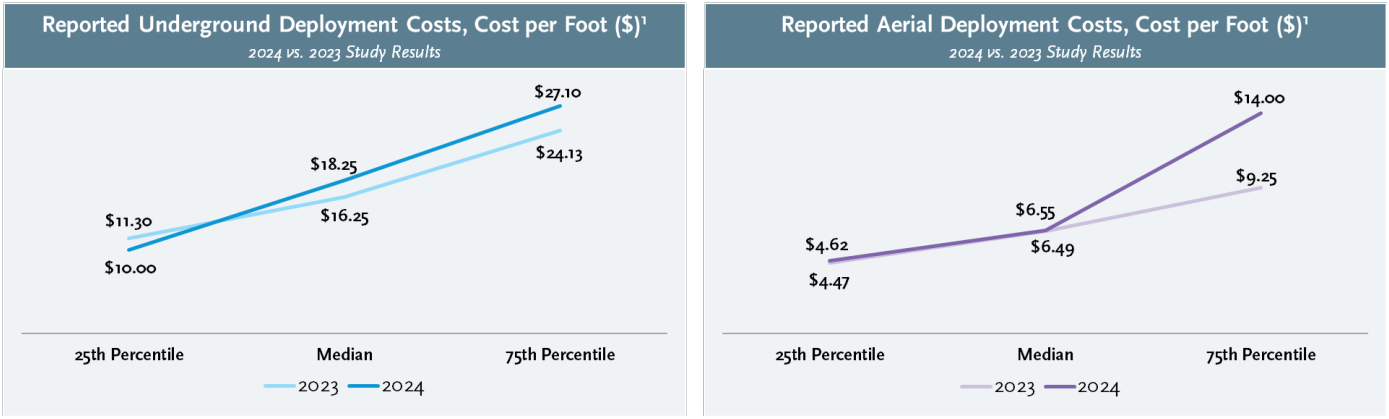
Deployment costs are reportedly higher than last year

Deployment costs reported for 2024 are generally higher than those from 2023. Median underground costs were 12% higher ($18.25 vs. $16.25), while median aerial costs were only 1% higher ($6.55 vs. $6.49).

At the upper end of the cost range, there were increases for both underground and aerial costs, with aerial showing the greatest increase. At the lower end of the range, costs were similar to those reported in 2023, with underground even showing a small decrease versus 2023 in the lower quartile.

Fig 2.2

Deployment Costs YoY Reported Cost Comparison



1: Cost per Foot inclusive of labor and materials components only
Source: Fiber Broadband Association Fiber Deployment Cost Study 2024, Cartesian

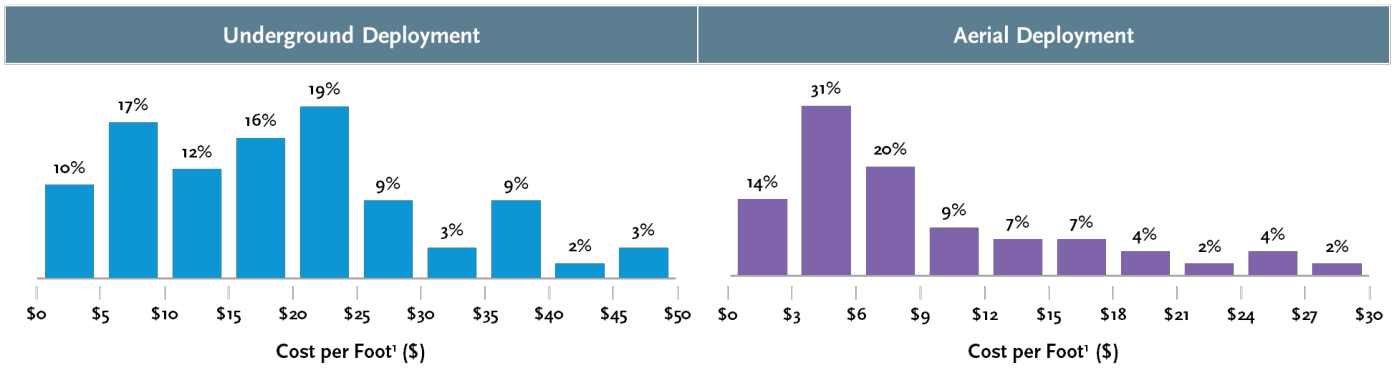
Underground deployments have a wide cost range compared to aerial deployments

Figure 2.3 illustrates the distribution of reported costs for underground and aerial builds. The range of underground costs are broadly distributed, with a few deployments costing up to $50/ft. Conversely, aerial deployments are largely clustered around the median with a small tail of more expensive deployments.

The wider distribution of underground deployment costs can be explained by variation in construction technique and terrain. The effect of these factors is explored later in this report.

Fig 2.3

Deployment Costs Distribution



1. Cost per foot inclusive of labor and materials components only
Source: Fiber Broadband Association Fiber Deployment Cost Study 2024, Cartesian

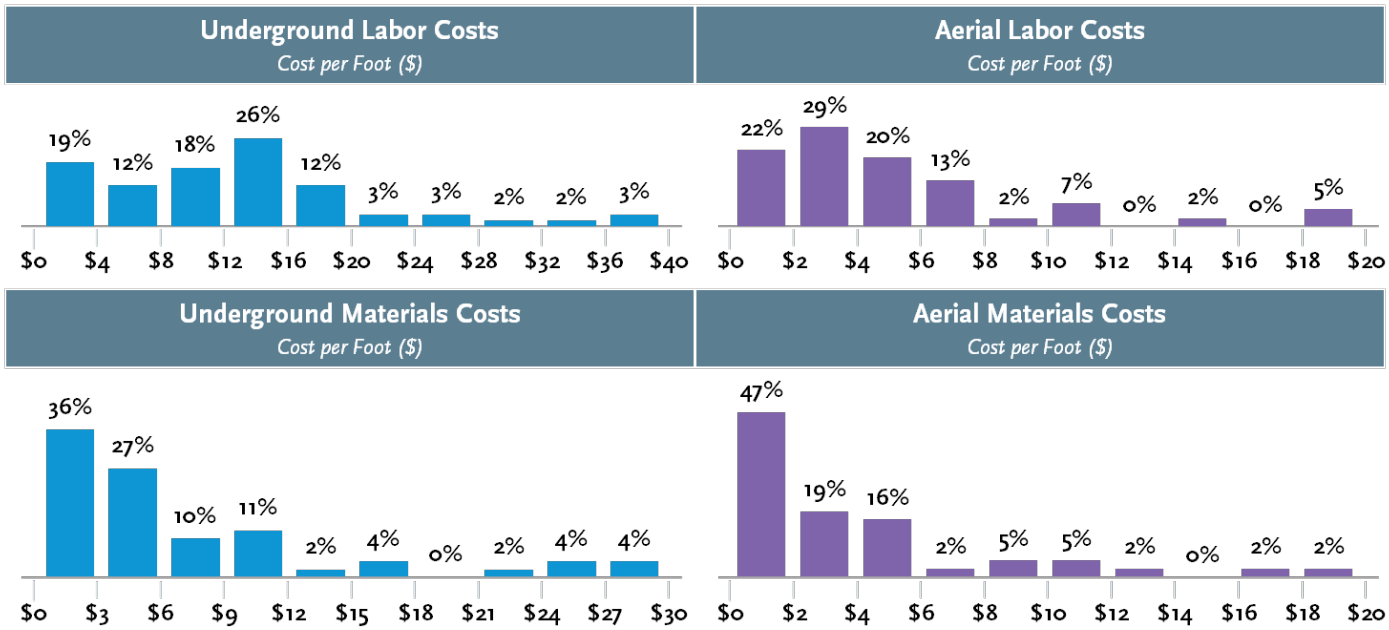
Labor costs account for 75% and 63% of underground and aerial deployment costs, respectively

Given that labor and materials are the primary drivers of deployment costs, it is useful to examine their individual cost distributions.

Unsurprisingly, labor contributes a much larger share of build costs than materials, with labor accounting for 75% of underground deployment costs, and 63% of aerial. The median labor and materials costs reported were $13.23/ft and $4.35/ft for underground deployments, while for aerial deployments, these were $4.00/ft and $2.40/ft respectively.

Fig 2.4

Deployment Input Costs Distribution



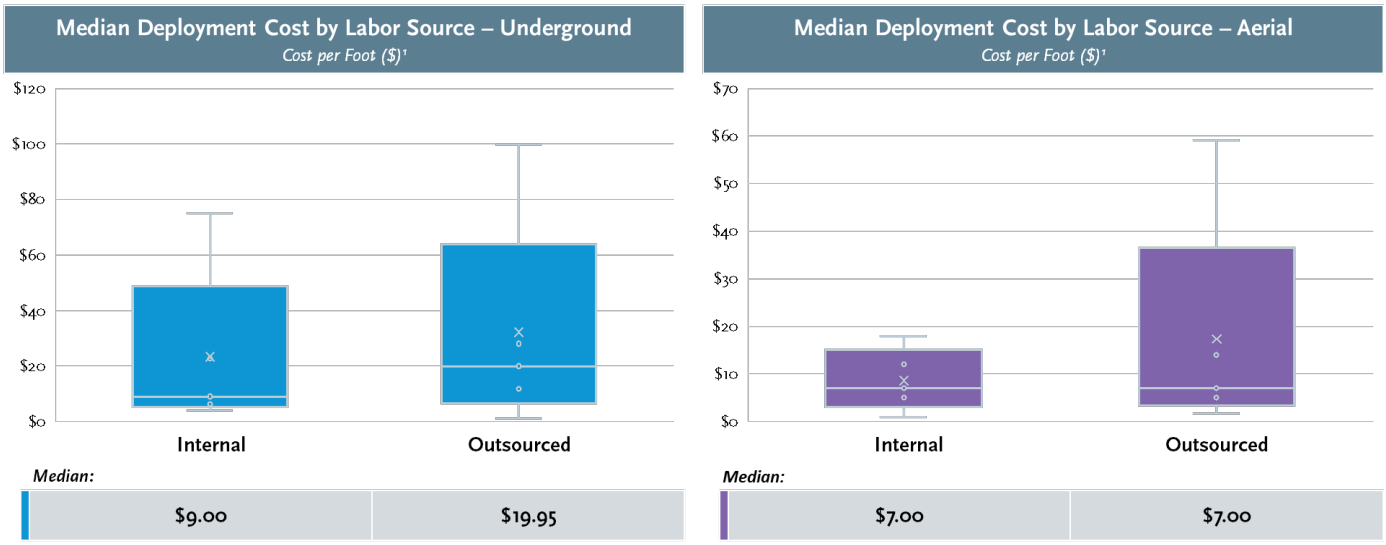
Source: Fiber Broadband Association Fiber Deployment Cost Study 2024, Cartesian

Median labor costs for underground deployments are three times those of aerial. Typically, underground deployments take more time and require more effort (digging, burying cables, etc.), while aerial deployments can be relatively labor light once make ready work is complete.

Roughly 75% of respondents use outsourced labor rather than internal teams. This figure was consistent across aerial and underground builds and is likely driven by the additional flexibility this provides. Municipalities and utilities reported that, considering the scale of their operations, they typically do not use internal labor for deployments.

Fig 2.5

Deployment Costs by Labor Source



1. Cost per foot inclusive of labor and materials components only
Source: Fiber Broadband Association Fiber Deployment Cost Study 2024, Cartesian

For underground deployments, the cost savings realized by using internal labor are significant on a per foot basis—typical deployment costs for internal vs. outsourced labor is $9.00/ft vs. $19.95/ft. Using this metric, outsourced labor for underground deployments appears to be twice as expensive as internal labor. However, outsourced labor can provide greater flexibility.

In contrast, for aerial deployments, there were no reported cost savings at the median: both internal and outsourced labor had similar median deployment costs of $7.00/ft. It's not immediately obvious why this should be the case, and it may be an artifact of the survey sample rather than a wider trend. Further, outsourced labor shows a much wider and expensive range of costs.

Deployment costs tend to increase alongside population density

Population density is a key factor when determining the economics of a fiber build. Denser areas are often favored as homes can be served with shorter cable runs; however, this typically comes with a higher cost per foot.

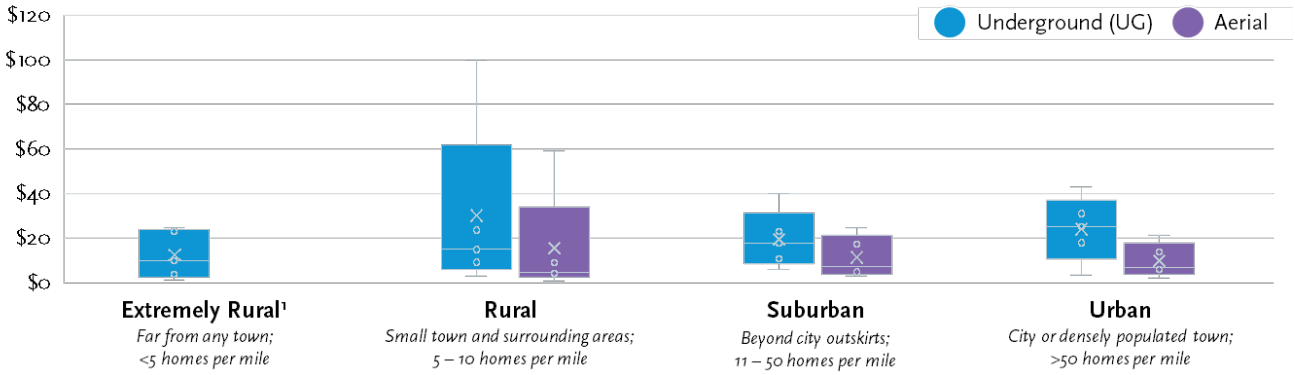
This is generally the case for our study responses—unit costs tend to increase with density, particularly for underground builds. Underground median costs range from $10.00/ft in extremely rural areas to $25.25/ft in urban areas. Similarly, aerial builds were reported with a median of $5/ft in rural areas, up to $7/ft in urban areas; however, there was little difference in aerial costs between urban and suburban areas.

Rural areas had the widest range of reported costs for both underground and aerial builds. This may reflect the wide variation in build conditions encountered in rural environments.

Fig 2.6

Deployment Cost Ranges by Population Density

Cost per Foot, Labor and Materials Only



	Extremely Rural[1] *Far from any town; <5 homes per mile*	Rural *Small town and surrounding areas; 5 – 10 homes per mile*	Suburban *Beyond city outskirts; 11 – 50 homes per mile*	Urban *City or densely populated town; >50 homes per mile*
Median:				
UG	**$10.00**	**$15.06**	**$18.00**	**$25.25**
Aerial	**-**	**$5.00**	**$7.20**	**$7.00**

Note: Box represents range between 25th and 75th percentiles and whiskers show full range of responses
1. Limited data for extremely rural aerial deployment
Source: Fiber Broadband Association Fiber Deployment Cost Study 2024, Cartesian

Construction technique greatly influences deployment costs

A variety of construction techniques are available for underground builds, each with their own particular strengths. A description of the most common methods is outlined below.

Fig 2.7

Description of Underground Construction Techniques

Construction Method	Description	Key Advantages
Boring	• Horizontal hole (~2" to 6" diameter, 3' to 5' deep) created via boring machine • Creates a straight path tunnel to install conduit • Push casing through borehole as it's being dug	• Requires less sophisticated (and therefore cheaper) machinery • Ideal for shorter distances and wider variety of soil types
Directional Boring	• Horizontal hole (~2" to 6") drilled 3' to 5' deep with a steerable surface level drill • Creates a tunnel in desired direction under the roadway/surface to install conduit	• Efficient for long distances • Useful when there's limited space • Minimizes disruption to infrastructure and environment
Trenching	• 2" to 6" wide cut trench, 2' to 6' deep via a chain blade and pulled through by a tractor • Conduit/cable paced at bottom of the cut • Trench is reinstated through compaction of removed spoils	• More visibility of the work area allowing for easier installation • Allows for easy future expansion
Microtrenching	• Narrow trench, up to 2" and no deeper than 18" • Conduit laid directly into the trench within a roadway • Routed through/under curbs or into surface vaults	• Advantageous for urban environments • Speed minimizes disruptions to traffic flow • Requires less ground surface restoration
Plowing	• 2" to 6" wide slice made 2' to 4' deep with a blade and pulled through with a tractor • Conduit/cable paced at bottom of the slice and covered with cutting spoils	• Beneficial when there's no obstacles along route and in softer soil environments • Creates less disturbance to surface area

Aerial builds either use Strand & Lash or All Dielectric Self Supporting (ADSS) cabling. The figure below provides a brief overview of each.

Fig 2.8

Description of Aerial Cable Installation Methods

Cabling Method	Description	Key Advantages
Strand & Lash Cables	• Steel strand first installed between utility poles, with tensioning equipment used to make it taut • Fiber optic cable laid alongside steel strand • Lashing wire then used to wrap around the strand and fiber cable – this secures the cables, and prevents it from sagging, or moving due to environmental factors	• Armored cables can be used to protect against potential rodent chew • Additional cables can be easily installed by overlashing • Telecom crews can do installations, do not require specialized power/utility crews
ADSS Cables	• All-dielectric cables, i.e., cables do not contain any metallic components • Attachment points installed on poles using clamps or dead-end hardware • ADSS cables strung between poles using tensioning equipment	• No messenger wires needed – ADSS cables can support its own weight • Minimal make ready costs, ~15 – 20% savings of total construction cost • ADSS cables are light-weight, making them easier to handle and install

For further information on underground methods, see Fiber Broadband Association's recent whitepaper on microtrenching and other deployment styles; for more details on aerial methods, check out Fiber Broadband Association's Fiber 101 Series.

Respondents were asked to identify their primary underground construction techniques and aerial cabling methods.

The most popular underground construction technique among respondents was directional boring, with nearly 53% of respondents primarily using the method. Its popularity is attributable to being a relatively well-established and cost-efficient technique for long distances.

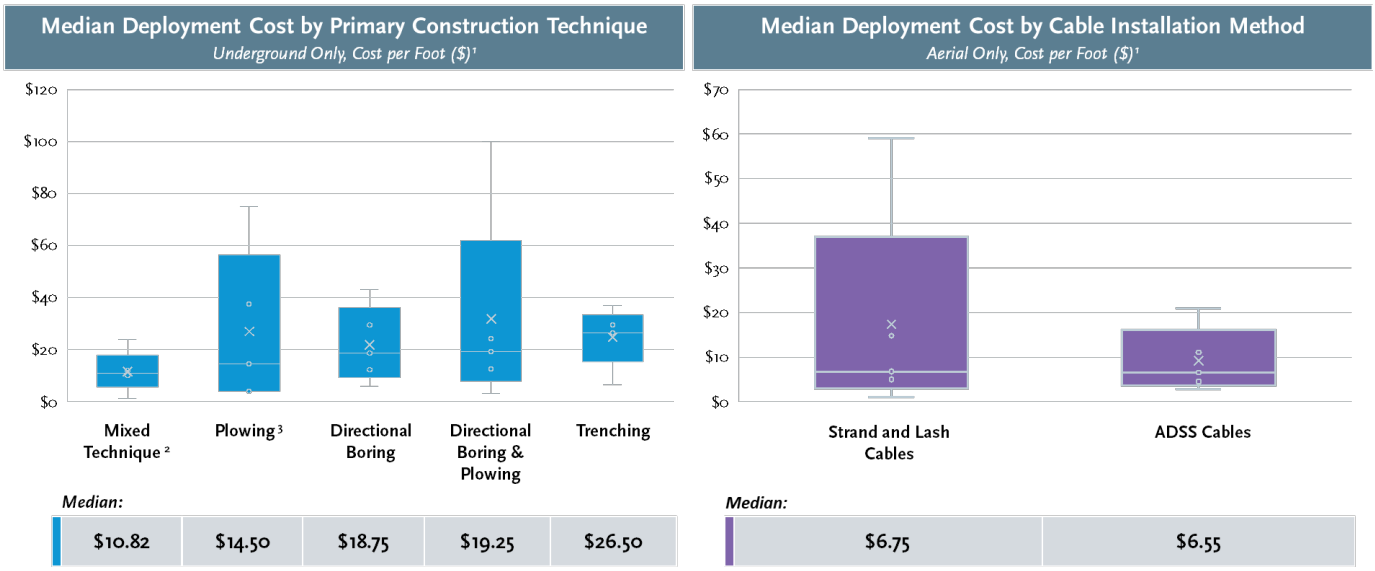
In terms of costs, Plowing had the lowest reported median cost in our sample at $14.50/ft. At the other end, trenching had the highest median cost at $26.50/ft although its upper quartile cost was lower than most other methods.

For aerial methods, there was limited difference in the median costs for Strand and Lash installations versus ADSS cables, at $6.75/ft vs. $6.55/ft, respectively. However, Strand and Lash had a much wider range of reported costs.

While the cost difference for aerial installations is widely debated in the industry, it is generally agreed that ADSS installations have lower make ready costs, potentially reducing overall project costs by ~15 – 20%[13].

Fig 2.9

Deployment Costs by Primary Infrastructure Usage



Note: Insufficient response count to display microtrenching construction technique
1. Cost per foot inclusive of labor and materials components only ; 2. Mixed technique is any combination of techniques listed excluding directional boring + plowing
3. Limited response count for builds using plowing as the primary technique
Source: Fiber Broadband Association Fiber Deployment Cost Study 2024, Cartesian

Where fiber is deployed can drastically impact deployment costs

We also asked respondents to identify the dominant terrain they encountered for underground builds. A choice was provided between Hard Clay, Soft Earth, Rocky, or a mix of terrains.

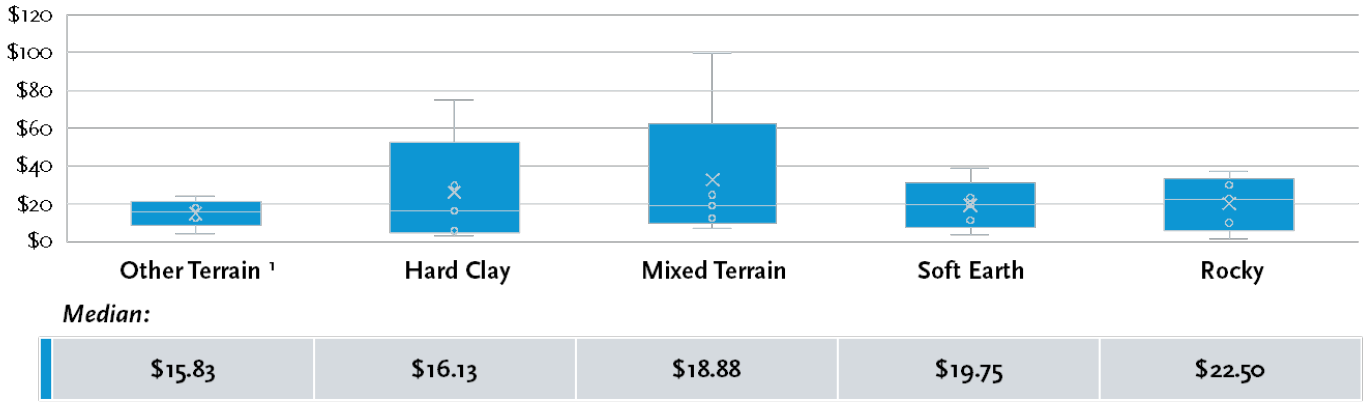
[13] AFL Global, Commscope, STL Tech

Consistent with expectations, rocky terrains proved to be the most challenging build environment, and the costliest, with reported median costs of $22.50/ft.

Fig 2.10

Underground Deployment Cost Ranges by Terrain Type

Cost per Foot, Labor and Materials Only



Median:				
$15.83	$16.13	$18.88	$19.75	$22.50

Note: Box represents range between 25th and 75th percentiles and whiskers show full range of responses
1. Other terrain includes sand, wetlands, and any other terrain type
Source: Fiber Broadband Association Fiber Deployment Cost Study 2024, Cartesian

Interestingly, respondents who indicated working with mixed terrains had the longest tail of higher costs, with rocky terrains being a consistent feature across these responses. Rocky and mixed terrains make it hard to predict what may be encountered under the surface. When dealing with more complex terrains, fiber crews may be required to employ multiple techniques, which could drive up build costs.

Renting poles from utility companies significantly increases aerial build costs

For aerial deployment, we also investigated how pole ownership affects deployment costs. Respondents were asked to identify if they were using their own poles or renting poles from others, and if the poles were existing or new.

Fig 2.11

Aerial Deployment Costs by Pole Ownership[1]

Cost per Foot, Labor and Materials Only

Median:	
$7.00	$4.90

Note: Box represents range between 25th and 75th percentiles and whiskers show full range of responses
1. Limited response count for deployments requiring new poles or "Other" pole ownership
Source: Fiber Broadband Association Fiber Deployment Cost Study 2024, Cartesian

Self-owned poles provide significant cost savings for fiber deployment. Respondents that use self-owned poles reported a median cost of $4.90/ft, versus $7.00/ft for those that rent space from other entities (e.g., utilities)—a cost savings of 43%. However, these estimates do not include the cost of placing, replacing, or maintaining poles.

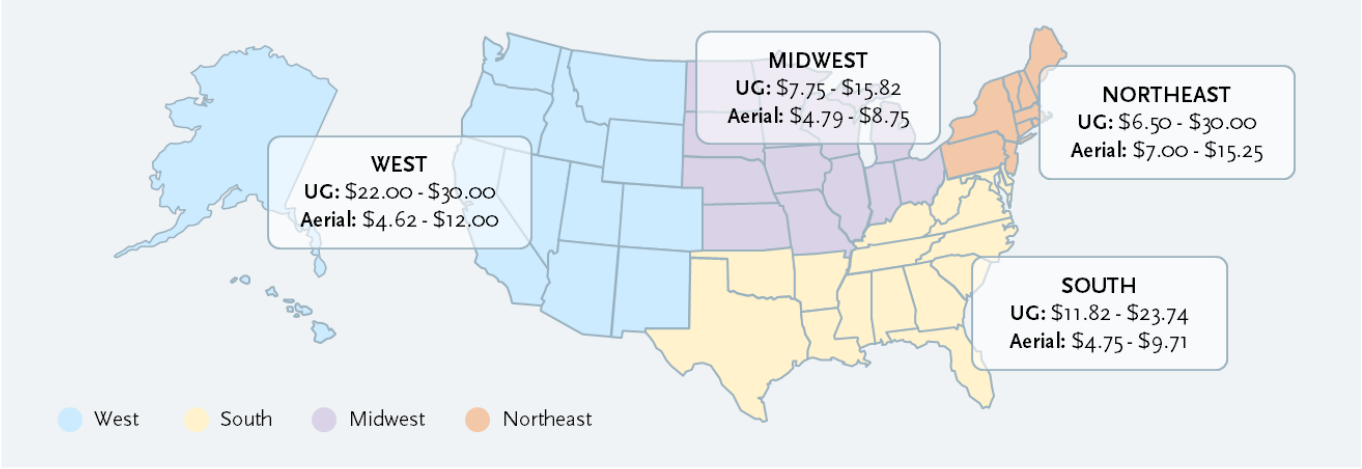
Western and Northeastern states had the highest reported cost ranges

Segmenting responses by location reveals how costs differ between regions.

Fig 2.12

Deployment Cost Ranges by Region

25th – 75th Percentiles for Cost per Foot, Labor and Materials Only



Source: Fiber Broadband Association Fiber Deployment Cost Study 2024, Cartesian

The data shows a more pronounced cost difference between regions for underground deployments as compared to aerial builds. This is in line with expectations, given that underground build costs are more sensitive to terrain.

For underground deployments, the highest median costs were observed for Western states, while Northeastern states had the widest range of costs. In both cases, this appears consistent with the prevalence of mountain areas and rocky ground. The highest costs for aerial deployments were observed in Northeastern states, while the Western states had the widest interquartile range of aerial costs.

Make ready costs and permitting are important drivers for fiber deployment

Besides direct labor and materials, fiber builds will encounter additional costs in permitting, engineering, and make ready, among others. These costs are typically estimated at a project level, rather than on a per-foot level.

Respondents were asked to specify what percentage of total project costs are attributed to these additional cost categories. Results show make ready costs form ~20% of total project costs, while engineering and permitting costs comprise ~12% and ~5%, respectively.

Make ready costs prepare poles for additional attachments in aerial deployments. These costs often cover surveying, engineering, and construction. Older and crowded poles tend to require more make ready work, resulting in higher costs. Make ready costs can also vary based on pole ownership and the state of existing attachments.

Anecdotally, some respondents noted a recent uptick in make ready costs as utility pole owners begin to deploy fiber themselves, and an uptick in permitting costs (4x – 10x increase) as local governments see increased demand for permits.

Respondents also repeatedly pointed to long permitting and approval lead times, causing project delays, budget overruns, and in some cases, switches between aerial and underground construction.

Customer drop / connection costs vary by last-mile network lengths

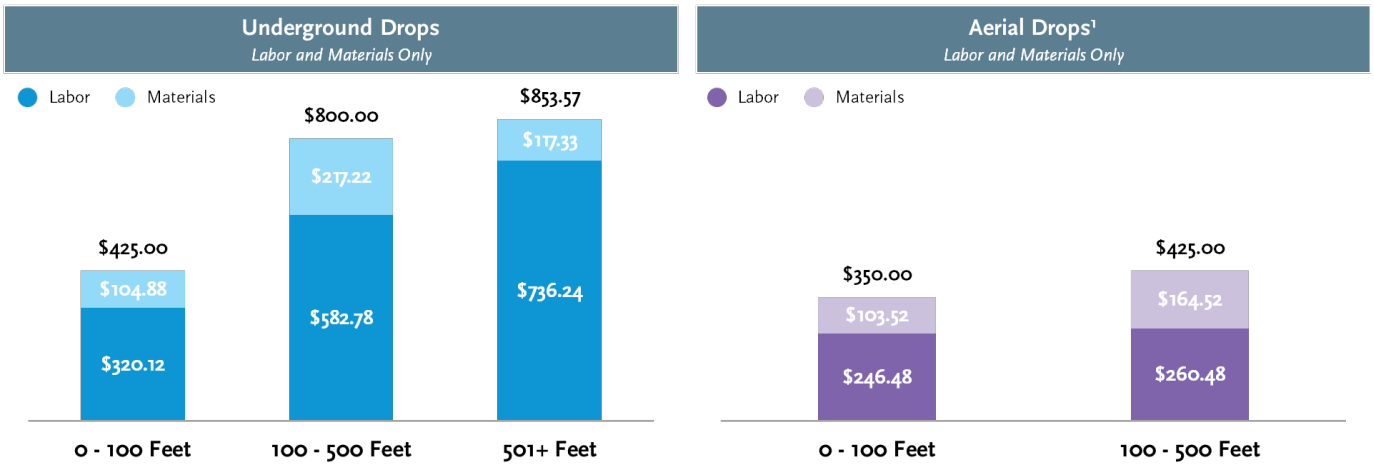
In addition to exploring the cost for fiber passings in the access network, we also researched the cost of individual customer connections, or "drops". Respondents were asked to detail their typical drop costs on a per-connection basis. For the purpose of this study, this excludes any costs associated with the ONT and any other CPE.

As observed with deployment costs, underground drops tend to cost more than aerial drops.

A drop of less than 100 feet typically costs $425 for underground versus $350 for aerial. For longer drops of between 100 and 500 feet, drops typically costs $800 for underground versus $425 for aerial.

Fig 2.13

Median Costs per Drop (CPD) by Drop Length



1: Limited data for aerial drops over 500 feet
Source: Fiber Broadband Association Fiber Deployment Cost Study 2024, Cartesian

The chart shows that cost differences between underground and aerial are more pronounced for longer drops, with the difference being driven primarily by labor. This reflects the additional effort that is required when digging a greater distance. In contrast, aerial drops are often far simpler and less labor intensive.

SECTION 3: COST TRENDS

This section looks at cost changes over the past year and how costs are expected to change over the coming year. In addition to reporting on how costs are changing, respondents were also asked to identify the main factors driving those changes.

Most respondents reported having higher deployment costs in 2024 than 2023

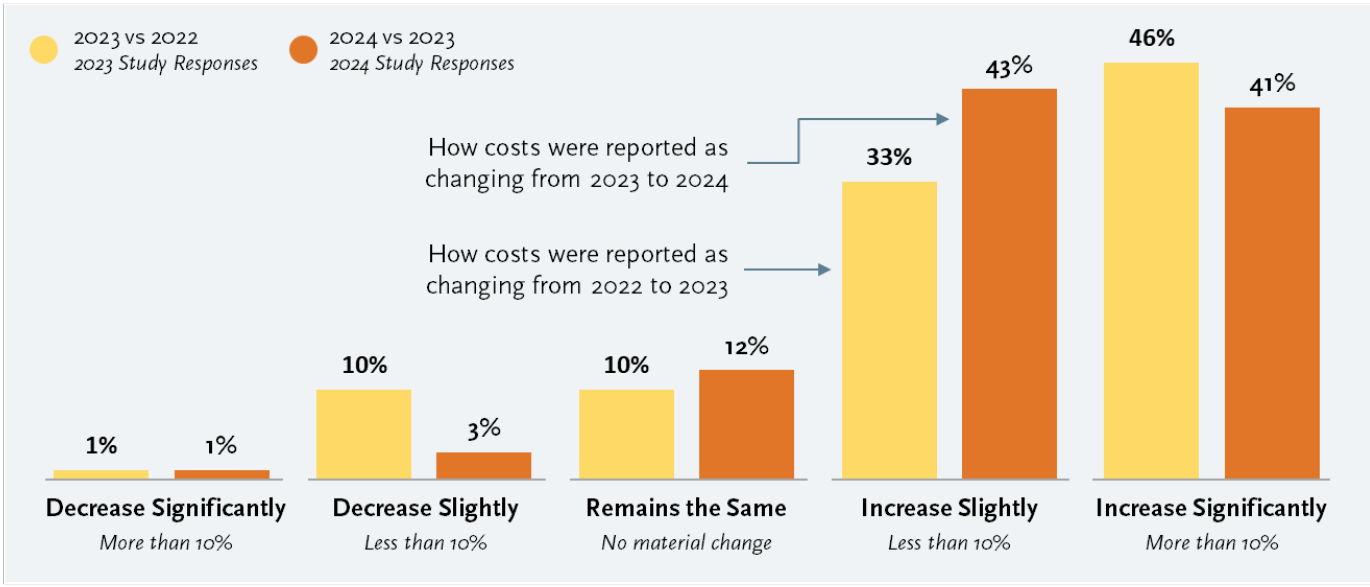
When asked to consider how deployment costs have changed over the past year, 84% of survey respondents reported cost increases.

As detailed in Section 2, the reported median costs increased by 12% and 1% year-on-year for underground and aerial deployments, respectively. Given that a significant majority of respondents reported cost increases in 2024, this largely aligns with how reported costs have increased from 2023 to 2024.

Fig 3.1

Reported YoY Deployment Cost Changes

Breakdown by Response Category, 2023 Study vs. 2024 Study



Source: Fiber Broadband Association Fiber Deployment Cost Study 2024, Cartesian

Compared to the responses from last year's study, a higher share of respondents this year reported a YoY increase in costs (84% vs. 79%). However, the share of respondents that experienced a significant increase in costs was lower (41% vs. 46%).

Larger than predicted share of respondents reported significant cost increases in 2024

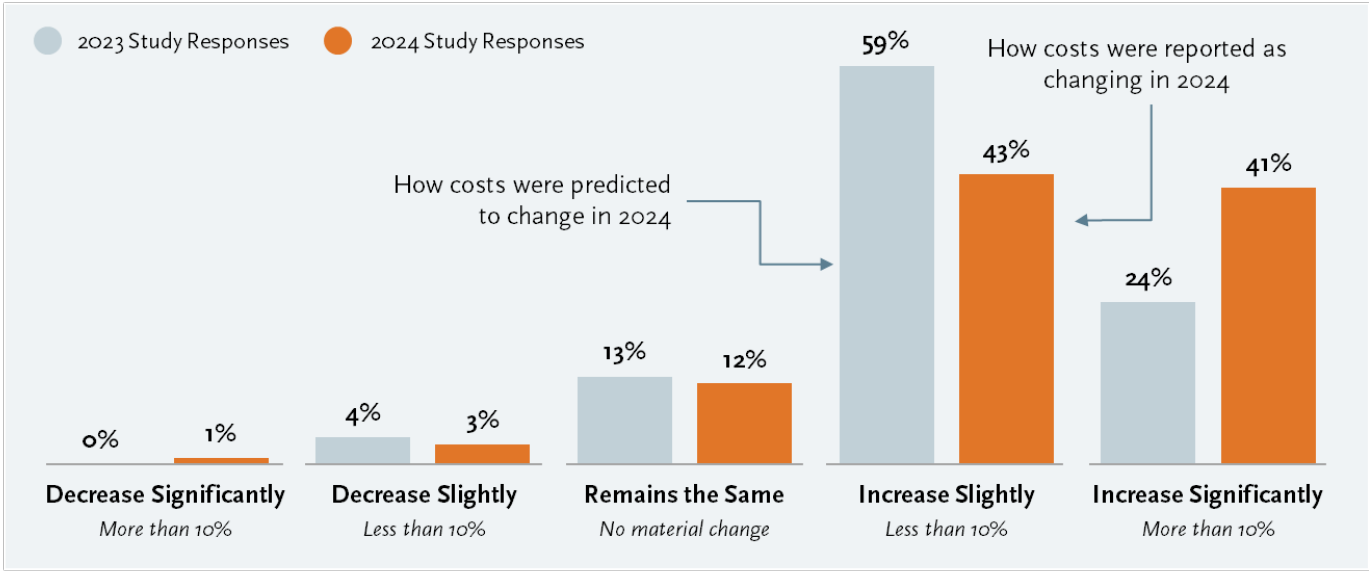
In last year's study we asked respondents to predict how deployment costs would change in 2024. We can now compare those predictions to how reported costs actually changed according to this year's respondents.

The chart below shows that the share of 2023 respondents expecting costs to increase, decrease, or hold steady was very similar to the share of 2024 respondents that experienced those trends. However, when we drill into the predictions for an increase in cost, a higher share of respondents experienced a significant increase (>10%) vs. a slight increase.

Fig 3.2

Expected and Reported YoY Deployment Cost Changes, 2023 to 2024

Breakdown by Response Category, 2023 Study vs. 2024 Study



Source: Fiber Broadband Association Fiber Deployment Cost Study 2024, Cartesian

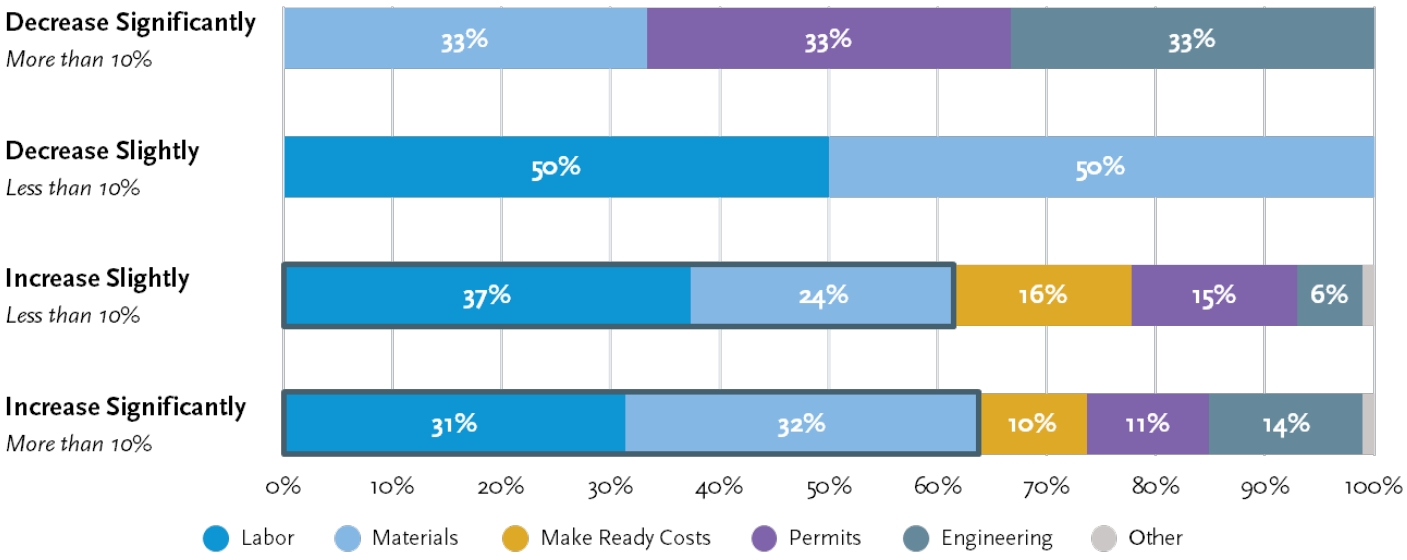
Labor and Materials are driving deployment cost increases

To uncover the causes of changes in cost, respondents were asked to identify the primary drivers for their build projects. Study participants could choose one or more options between labor, materials, make ready costs, engineering, permits, and "other".

Fig 3.3

Identified Drivers of Reported Cost Changes

Reported Cost Change (Current Year vs. Last Year), 2023 – 2024



Source: Fiber Broadband Association Fiber Deployment Cost Study 2024, Cartesian

Among those who reported significant cost increases (i.e., greater than 10%) labor was cited as the primary driver 31% of the time, while materials were cited 32% of the time. For those who reported slight cost increases (i.e., less than 10%), labor was cited 37% of the time compared to 24% for materials. Together, labor and materials are the dominant drivers for higher deployment costs in 2024.

Beyond labor and materials, make ready costs and permits were also often-cited as primary drivers for cost increases. Among those who reported significant increases, make ready costs were cited 10% of the time, while permits were cited 11% of the time.

Costs are expected to increase again next year, but not as steeply as 2024

As before, respondents were asked to predict how costs are likely to change in the coming year.

The majority of respondents (80%) indicated that deployment costs are likely to increase in 2025. Over half (55%) of all respondents predict that increases will remain below 10%, and only a quarter are bracing for significant cost increases (over 10%). An even smaller share of respondents, 5%, expect costs to fall.

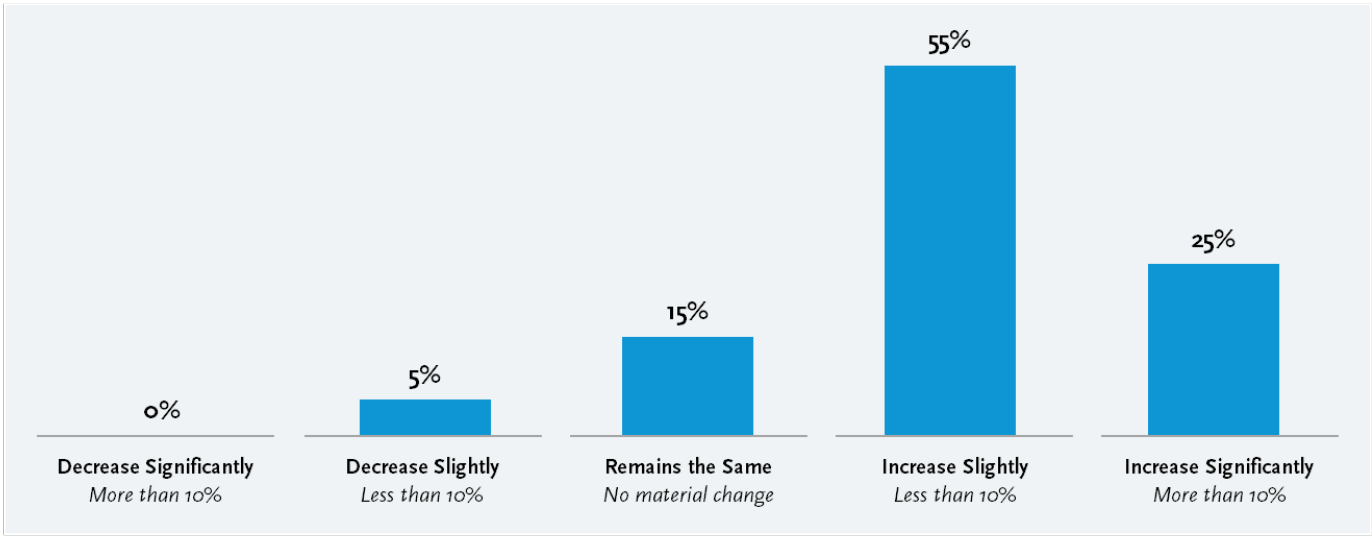
As 41% of this year's respondents reported significant cost increases (>10%), the outlook for next year is more optimistic. Only 25% expect large cost increases to continue in 2025.

Interestingly, these predictions for 2025 closely mirror the predictions that our respondents had last year for 2024. We will report next year on whether this optimism was well founded.

Fig 3.4

Predicted YoY Deployment Cost Changes, 2024 – 2025

Change in Deployment Costs from Current Year to Next Year by Level of Change



Source: Fiber Broadband Association Fiber Deployment Cost Study 2024, Cartesian

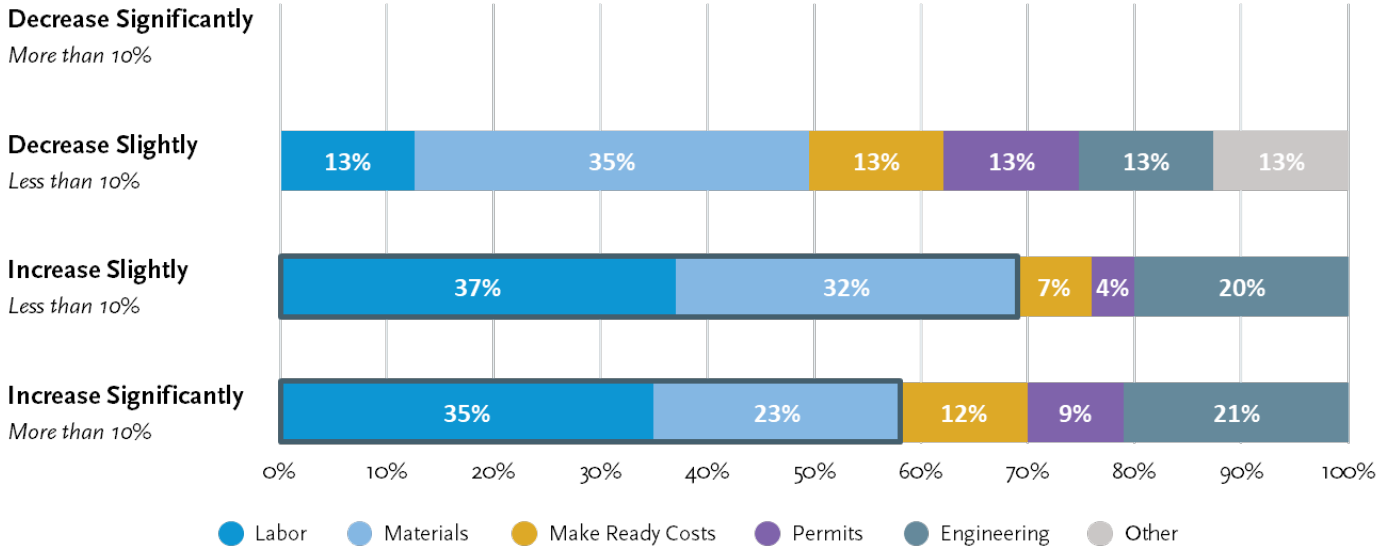
Future cost increases are being driven by labor, materials, and engineering

Consistent with last year's findings, labor and materials are expected to be the main drivers of increasing deployment costs in 2025. Among respondents who expect that costs will increase significantly, labor was cited 35% of the time, while materials was cited 23% of the time.

Fig 3.5

Expected Drivers of Future Cost Changes

Expected Cost Change (Next Year vs. Current Year), 2024 – 2025



Source: Fiber Broadband Association Fiber Deployment Cost Study 2024, Cartesian

Engineering costs are expected to have a material impact among those that predict higher costs next year; engineering was the third most cited driver of predicted cost changes. For those who expect significant cost increases, engineering was cited 21% of the time.

Permits and make ready costs round out the expected drivers for cost changes. Make ready costs were cited 12% and permits were cited 9% of the time among those who predict costs to increase significantly.

Beyond the financial aspect, permits and make ready costs are top of mind for many providers. With many BEAD deployment projects poised to start in the coming year, efficiency with permitting and pole readiness are key concerns.

CONCLUSION

Fiber is set to have a stellar performance in 2025

The momentum behind fiber deployment continued in 2024 and at a household level, 76.5M homes are now passed by fiber, representing 56.5% of all US households.

Recent gains in fiber coverage were achieved despite economic headwinds, cost pressures, and the tail end of disruptions in the supply chain. Despite these challenges, we saw several announcements of large-scale build plans from ILECs such as AT&T and Verizon. The willingness to invest in this economic climate reflects the confidence in fiber broadband as an enduring, long-term asset.

Crucially, fiber is no longer only in urbanized areas, with more and more rural areas gaining access to fiber. As BEAD funding starts to flow through to providers next year, we will see even more rural communities connected with fiber.

Together with investment from private capital, we expect 2025 to be another record deployment year for fiber and industry will be well on its way to passing 90% of homes by the end of the decade.

In terms of costs, reported deployment costs increased in 2024, due primarily to more expensive labor and materials. These factors are expected to drive higher costs in 2025; however, cost increases are expected to be less than those experienced this year.

As in last year's study, reported costs varied significantly between projects depending on construction method and terrain. We anticipate that cost optimization will become even more important in coming years as providers build into more-costly rural areas.