DRAFT North Carolina Broadband Workforce Development Plan December 2023

One key to success for the BEAD investment is ensuring North Carolina has a skilled and diverse workforce to deploy broadband technologies. This section shares the results of a collaborative planning process that state has undertaken to understand the impact of the BEAD investment (combined with an additional nearly $1 billion from the American Rescue Plan Act that North Carolina appropriated for broadband deployment) will have on our state's workforce needs and to develop strategies that will build a more diverse and high-quality broadband talent pipeline.

Creating a Workforce Team

In spring 2023, North Carolina created a statewide Broadband Workforce Advisory Committee to provide guidance to the N.C. Department of Information Technology's Division of Broadband & Digital Equity (the division). This committee (see Appendix A for a roster) comprises representation from:

- four internet service providers
- a national contracting firm that builds and deploys fiber networks
- two fiber manufacturers
- a North Carolina leader from Communications Workers of America, the state's only collective bargaining entity in the sector
- the N.C. Department of Public Instruction
- the NCWorks Commission, which steers the state's Workforce Innovation and Opportunity Act system
- the N.C. Community College System Office
- two community college workforce and continuing education leaders
- a leader from a local workforce board
- two community-based organizations with statewide reach
- two national broadband employer associations
- the governor's office workforce policy staff person

Facilitated by the division, this committee held its first virtual meeting in July 2023 during which it offered feedback to initial labor market analyses, employer listening sessions, and an education capacity scan. The committee met again in September 2023 to provide feedback on draft strategies under development for this plan. The committee will meet in December 2023 to review feedback from the draft plan posted for public comment to offer final input before the division submits its initial proposal for North Carolina.

Understanding the Landscape

The division carried out quantitative and qualitive activities to understand the projected impacts from broadband investments on the state's labor market, to understand broadband employers' workforce needs, and to learn about current education and training capacity for this sector. More specifically, the division:

- Contracted with a labor market analyst in the state to conduct a detailed quantitative projection of occupational growth estimated to result from North Carolina's combined BEAD and American Rescue Plan Act broadband investments. This analysis combined

existing published research frameworks about the structure of broadband sector with state-specific analyses of public data to model the possible industrial and occupational impacts of a $2.5 billion investment in BEAD and American Rescue Plan funds in North Carolina's broadband sector over a five-year period.
- Convened two broadband employer listening sessions attended by 12 companies, two associations, and representation from Communications Workers of America.
- Conducted 17 interviews with educators, trade associations, workforce board staff, education leaders, and community-based organizations across North Carolina for the education and training capacity scan.

The following section shares results from these analyses.

Labor Market Analysis of the Impact of Broadband Investments on North Carolina

Summary: This section presents the detailed labor analysis prepared to estimate the potential industrial and occupational impacts on North Carolina's broadband sector of a $2.5 billion investment in BEAD and American Rescue Plan funds over a five-year period. The number of direct jobs potentially attributable to a BEAD Program grant of $1.5 billion, assuming all the jobs were created at once, would be 3,832 direct jobs; when approximately another $1 billion in federal American Rescue Plan funds are included, the potential impact rises to 6,173 direct jobs. On an annualized basis, BEAD funding will yield an estimated 766 direct jobs per year in North Carolina's broadband sector over a five-year period. When American Rescue Plan funds are included, the potential employment impact rises to 1,235 direct jobs per year.

1. Overview of Labor Analysis

Federal funds extended to North Carolina under the Bipartisan Infrastructure Law will support the expansion of high-speed internet service into communities isolated from the economic, educational, and cultural opportunities available through the internet. Yet the money provided by the Broadband Equity Access and Development (BEAD) Program is only one part of the solution for attaining the state's ambitious goal of all homes and businesses in the state having access to high-speed internet.[1] Indispensable to the attainment of that goal is the availability of a properly sized, qualified, and compensated broadband workforce.

This labor analysis provides an overview of the state's current and potential broadband workforce. The analysis begins by estimating the size of North Carolina's existing broadband workforce in terms of industrial composition and occupational structure. Next, the analysis explores issues of job trends, qualifications, and quality in the broadband sector. The analysis then considers salient demographic traits of the existing and potential broadband workforce (*e.g.*, gender, race/ ethnicity, and age). Finally, the analysis reviews current projections for growth in the broadband workforce absent BEAD funding and future projections for broadband workers reflective of a $1.5 billion federal BEAD grant and $0.9 billion in federal monies for high-speed internet expansion extended to North Carolina under the American Rescue Plan.[1]

The aim of this labor analysis is to establish a common baseline for planning with such BEAD Program stakeholders as industry partners, educational providers, and organized labor. By combining published research related to the broadband sector with state-specific analyses of public data collected by agencies like the U.S. Census Bureau, U.S. Bureau of Labor Statistics, and N.C. Department of Commerce, this labor analysis will help frame statewide stakeholder engagements scheduled for later in 2023. By sharing the research with key informants and incorporating their knowledge, this iterative planning process can nurture the growth of a diverse broadband workforce that enjoys good jobs and career pathways.

2. A Snapshot of North Carolina's Broadband Sector

Despite their ubiquity, terms like "broadband industry" and "broadband workforce" lack uniform definitions and standardized statistical categories within federal industrial and occupational classification systems.[2] Establishing consistent definitions therefore is a first step to understanding North Carolina's broadband sector—a sector comprised of business establishments engaged in specific industries and workers engaged in specific occupations.

2.1 Defining North Carolina's Broadband Industry

The basic analytical unit featured in business data collected by public statistical agencies is a business establishment, defined as "a single physical location where business is conducted, or where services are performed."[3] Each establishment belongs to an industry, which is a grouping of "business establishments according to similarities in their production processes."[4] Adopted in 1997, the North American Industry Classification System (NAICS) is the standard taxonomy used by public statistical agencies; in this hierarchical framework, 1,012 individual industries collapse ultimately into 20 broad sectors.[5] Each level in the hierarchy caries a specific code spanning from two digits (a broad sector) to six digits (an individual industry).[6]

There is no specific NAICS code for the broadband industry. From the perspective of a user of broadband services, the industry seemingly would be the subset of the larger information sector (NAICS: 51) involved in providing internet connections and/or service to a residence or office, irrespective of the underlying technology (*i.e.*, digital subscriber line, cable modem, wireless, fiber, satellite, broadband over satellite).[7] In actuality, the broadband industry is more expansive and involves all of the entities that "are working to build, maintain, operate, and/or administer high-speed internet."[8] For instance, a firm in the larger telecommunications sector (NAICS: 517) depends on the manufacturing sector (NAICS: 31-33) to produce the necessary equipment and the construction sector (NAICS: 23) to build the needed infrastructure.[9]

A 2020 study by researchers at the University of Massachusetts-Amherst identified six individual industries that would be most directly impacted by sizable federal investment in broadband expansion.[10] Those industries were the following (in order of six-digit NAICS code): Power and Communications Line and Related Structure Construction (237130), Fiber Optic Cable Manufacturing (335921), Miscellaneous Electrical Equipment and Component Manufacturing (335999), Cable and Other Subscription Programming (515210), Wired Telecommunication Carriers (517311), and Wireless Telecommunications Carriers (517312).[11]

2.2 Estimating the Size of North Carolina's Broadband Industry

Table 1 presents data on the size of the six industries introduced in Section 2.1 for North Carolina in 2021.[12] That year, North Carolina was home to an estimated 1,422 business establishments in broadband industries. Between them, Wired Telecommunications Carriers and Wireless Telecommunications Carriers (NAICS: 517311/12) accounted for 61% of the total, with another 34% of establishments focused on Power and Communication Line and Related Structure Construction (NAICS: 237130). In total, these industries accounted for 0.5% of all of the state's business establishments.

Table 1. Estimated Size of Key Industries in the Broadband Sector, North Carolina, 2021
Source: N.C. Department of Commerce: Labor and Economic Division, Quarterly Census of Employment and Wages, Average Annual Values, 2021.

Six-Digit NAICS Code (2017)	NAICS Industry Title (2017)	Number of Business Establishments	Share of Sector Total		Average Annual Payroll Employment	Share of Sector Total
237130	Power and Communication Line and Related Structures Construction	486	34.2%		9,875	27.1%
335921	Fiber Optic Cable Manufacturing	15	1.1%		3,288	9.0%
335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing	25	1.8%		668	1.8%
515210	Cable and Other Subscription Programming	26	1.8%		640	1.8%
517311	Wired Telecommunications Carriers	617	43.4%		18,512	50.9%
517312	Wireless Telecommunications Carriers	253	17.8%		3,401	9.3%
	Sector Total	1,422	100.0%		36,384	100.0%

In terms of payroll employment, the six key industries shown in **Table 1** supported, on average, 36,384 payroll positions; in other words, 0.8% of all payroll jobs in North Carolina were in this set of industries.[13] The greatest number of jobs in absolute and relative terms was found in the Wired Telecommunications Carriers industry (51%), followed by the Power and Communication Line and Related Structure Construction industry (27%). Notably, Fiber Optic Cable Manufacturing accounted for 9% of all jobs in the sector, which reflects the presence of major manufacturers in the state (*e.g.*, Corning).

2.3 Defining North Carolina's Broadband Occupations

To produce their goods or deliver their services, business establishments depend on workers engaged in specific occupations. An occupation is "a category of jobs that are similar with respect to the work performed and the skills possessed by the incumbents."[14] Note that occupations are independent of industry. For example, an accountant who works for an accounting firm will be in a different industry than one who works in-house for a manufacturing firm. Furthermore, a business in a given industry will employ people in many different occupations, although there are clear industry patterns: a construction firm, for one, would rely on a different occupational mix than a hospital would.

Public statistical agencies use the Standard Occupational Classification System (SOC) to classify "all occupations in which work is performed for pay or profit."[15] Under this hierarchical framework, 867 detailed occupations collapse ultimately into 23 broad occupational groups.[16] Each hierarchical level caries a specific numerical identifier in which the first two digits designate a major occupation group, with additional digits added until arriving at a six-digit code that identifies a detailed occupation.[17]

As with the industry data discussed previously, there are no specific SOC codes for occupations connected to the broadband sector. Existing research, meanwhile, varies greatly in terms of the occupations included as part of the broadband sector.

The same University of Massachusetts-Amherst study referenced in Section 2.1 identified 130 occupations that would be most directly impacted by sizable federal investment in broadband expansion. Yet over half of the estimated impact was concentrated in 10 detailed occupations, which are presented in **Table 2** in descending order of their projected national impact. [18]

Table 2. Over Half of All Jobs Linked to Federal Investments in Broadband Expansion Are Projected to Occur in 10 Detailed Occupational Categories (Ranked in Order), United States

Source: Marcela Escobari, Dhruv Gandhi, and Sebastian Strauss, How Federal Infrastructure Investment Can Put America to Work (Washington, DC: Brookings Institution, 2021), 15.

SOC Code	SOC Detailed Occupational Title
49-2022	**Telecommunications Equipment Installers and Repairers (except line installers)**
49-9052	**Telecommunications Line Installers and Repairers**
41-3091	Sales Representatives of Services (except advertising, insurance, financial services, and travel)
43-4051	Customer Service Representatives
47-2061	Construction Laborers
49-9051	**Electrical Power-Line Installers and Repairers**
15-1253	Software Developers and Software Quality Assurance Analysts and Testers
13-1198	Project Management Specialists and Business Operations Specialists (All Others)
49-1011	First-Line Supervisors of Mechanics, Installers and Repairers
17-2072	**Electronic Engineers (except computer)**
Note: Detailed occupations in **SHADED BOLD** are highly critical (specialized) to broadband expansion.	

Unsurprisingly, four of the most impacted occupations—those with SOC codes beginning with 49—are installation, maintenance, and repair occupations. Workers capable of performing tasks like installing telecommunications equipment, laying telecommunications lines, and repairing electrical power systems are essential to expanding broadband access. These also are highly critical (specialized) occupations vital to broadband expansion, as well as occupations that generally must be performed in person. (See Section 3 for a discussion of job characteristics.)

Table 3. Top 20 Detailed Occupations Most Highly Impacted by Federal Investments in Broadband Expansion (Listed by SOC Code), United States
Sources: America Achieves and Rural Innovation Strategies, Creating and Expanding a Diverse Broadband Workforce with Good Jobs and Career Pathways: Broadband Equity, Access, and Deployment (BEAD) Program Playbook for Eligible Entities (New York: America Achieves, 2022), 24; and Marcela Escobari, Dhruv Gandhi, and Sebastian Strauss, How Federal Infrastructure Investment Can Put America to Work (Washington, DC: Brookings Institution, 2021), 15.

Major SOC Group	SOC Code	SOC Detailed Occupational Title
Management	11-9021	Construction Managers
	11-9179	Personal Services Manager, All Others
Business and Financial Operations	13-1198	Project Management Specialists and Business Operations Specialists (All Others)
Computer and Mathematical Operations	15-1253	Software Developers and Software Quality Assurance Analysts and Testers
Architecture and Engineering	**17-2072**	**Electronic Engineers (except computer)**
Sales and Related	41-3091	Sales Representatives of Services (except advertising, insurance, financial services, and travel)
Office and Administrative Support	43-4051	Customer Service Representatives
Construction and Extraction	47-1011	First-Line Supervisors of Construction Trades and Extraction Workers
	47-2061	Construction Laborers
	47-2073	Operating Engineers and Other Construction Equipment Operators
	47-2111	Electricians
Installation, Maintenance, and Repair	49-1011	First-Line Supervisors of Mechanics, Installers and Repairers
	49-2021	**Radio, Cellular, and Tower Equipment Installers and Repairers**
	49-2022	**Telecommunications Equipment Installers and Repairers (except line installers)**
	49-9051	**Electrical Power-Line Installers and Repairers**
	49-9052	**Telecommunications Line Installers and Repairers**
	49-9098	**Helpers, Installation, Maintenance and Repair Workers**
Production	51-2021	Coil Winders, Tapers, and Finishers
	51-2028	Electrical, Electronics, & Electromechanical Assemblers (except coli winders, tapers, and finishers)
	51-2090	Miscellaneous Assemblers and Fabricators
Note: Detailed occupations in **SHADED BOLD** are highly critical (specialized) to broadband expansion.		

While studies differ in terms of which occupations are included in the broadband sector, the occupations listed in **Table 2** appear regularly. For instance, research published by America Achieves and Rural Innovation Strategies identified 15 detailed occupations—including eight of those shown on **Table 2**—that would be most impacted by broadband expansion.[19] **Table 3** therefore adds those occupations to the existing ones, along with two additional critical industry identified by the University of Massachusetts-Amherst to create a list of 20 key occupations that will be used in the rest of this landscape analysis.

As noted earlier, occupations are independent of industry, meaning that persons with a given occupation may work in any number of industries. Yet specific occupations tend to cluster in specific industries. National estimates from the U.S. Bureau of Labor Statistics, for example, found that 32% of all Radio, Cellular, and Tower Equipment Installers and Repairers (SOC: 49-2021) worked in the Telecommunications subsector (NAICS: 517); in contrast, just 8% of all Customer Service Representatives (SOC:43-4051) were in that grouping.[20]

2.4 Estimating the Size of North Carolina's Broadband-Related Occupations

Table 4 presents data on occupational employment for the top 20 occupations identified previously for North Carolina in 2022, the latest year with complete data.[21] That year, North Carolina was home to an estimated 383,060 workers in those 20 detailed occupations; put differently, those fields accounted for eight of every 100 jobs in the state. Customer service representative accounted for almost a quarter of the collective total (23%), followed by miscellaneous assemblers and fabricators (14%), sales representatives (9%), project management specialists (9 percent), and construction laborers (8%).

Another way of gauging the size of North Carolina's workforce in occupational categories most relevant to the broadband sector is through use of a location quotient, which compares a given occupational category's employment contribution to total employment in the state to the same occupational category's overall contribution to national employment. A quotient greater than one suggests an occupation in which the state may have a relative advantage. Looking at the location quotient column in **Table 4** reveals that North Carolina has 2.2 times as many construction managers as would be expected, about as many customer service representatives as would be expected, and 45% fewer electronic engineers than would be expected.[22]

Table 4. Estimated Occupational Employment in 20 Detailed Occupations Highly Impacted by Federal Investments in Broadband Expansion (Listed by SOC Code), North Carolina, All Industries, May 2022
Source: N.C. Department of Commerce: Labor and Economic Division, Occupational Employment and Wage Statistics Program, May 2022.

Major SOC Group	SOC Code	SOC Detailed Occupational Title	Estimated Employment	Share of Sector Total	Location Quotient
Management	11-9021	Construction Managers	20,660	5.4%	2.17
	11-9179	Personal Services Manager, All Others	##	##	##
Business and Financial Operations	13-1198	Project Management Specialists and Business Operations Specialists (All Others)	32,490	8.5%	0.96
Computer and Mathematical Operations	15-1253	Software Developers and Software Quality Assurance Analysts and Testers	8,210	2.1%	1.33
Architecture and Engineering	**17-2072**	**Electronic Engineers (except computer)**	**1,830**	**0.5%**	**0.55**
Sales and Related	41-3091	Sales Representatives of Services (except advertising, insurance, financial services, and travel)	33,480	8.7%	0.99
Office and Administrative Support	43-4051	Customer Service Representatives	89,500	23.4%	0.99
Construction and Extraction	47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	30,290	7.9%	1.34
	47-2061	Construction Laborers	31,600	8.2%	0.99
	47-2073	Operating Engineers and Other Construction Equipment Operators	14,190	3.7%	1.07
	47-2111	Electricians	22,640	5.9%	1.04
Installation, Maintenance, and Repair	49-1011	First-Line Supervisors of Mechanics, Installers and Repairers	19,110	5.0%	1.02
	49-2021	**Radio, Cellular, and Tower Equipment Installers and Repairers**	**420**	**0.1%**	**1.03**
	49-2022	**Telecommunications Equipment Installers and Repairers (except line installers)**	**5,090**	**1.3%**	**0.96**
	49-9051	**Electrical Power-Line Installers and Repairers**	**5,630**	**1.5%**	**1.50**
	49-9052	**Telecommunications Line Installers and Repairers**	**3,070**	**0.8%**	**0.91**
	49-9098	**Helpers, Installation, Maintenance and Repair Workers**	**3,890**	**1.0%**	**1.32**
Production	51-2021	Coil Winders, Tapers, and Finishers	320	0.1%	0.94
	51-2028	Electrical, Electronics, & Electromechanical Assemblers (except coli winders, tapers, and finishers)	8,050	2.1%	0.93
	51-2090	Miscellaneous Assemblers and Fabricators	52,590	13.7%	1.15
		Total	383,060	100.0%	1.07

Notes: 1) Detailed occupations in **SHADED BOLD** are highly critical (specialized) to broadband expansion; 2) " ##" denotes a category with missing or suppressed data; 3) the employment values are estimates subject to statistical error; and 4) the location quotient compares the employment contribution of a given occupation in North Carolina to total statewide employment relative to the same occupation's contribution to the national economy; a value greater than 1 suggests an occupation in which North Carolina may have a relative advantage.

When it comes to the six occupational categories considered to be the most critical or highly specialized ones for the purposes of broadband expansion (denoted in **shaded bold** in **Table 4**), North Carolina performs relatively in line with the nation as a whole. Expected values for key telecommunications workers like telecommunications equipment installers and repairers and radio, cellular, and tower equipment repairers are close to one. When it comes to relative advantages, the state has 50% more electrical power-line installers and repairers than would be expected and 32% more helpers, installation and repair workers than would be expected. Relative disadvantages appear for telecommunications line installers and repairers (9% less than expected) and electronic engineers (45% less than expected).

Remember that not all of the persons working in broadband-related occupations actually are working in the six broadband-related industries identified in Section 2.1. Individuals in the appropriate occupational categories may be able to move into new opportunities in broadband industries, but they may require industry-specific training to transition successfully. At the same time, employees who change industries may leave behind job gaps in their old industries. (See Section 5 for a discussion of workforce projections.) Additionally, individuals working in the broadband sector may perform different tasks depending on their firm's needs; for example, line installer and repairer may perform one set of tasks if their firm is engaged in expanding their networks and different tasks if the firm is focused on maintaining existing infrastructure.

To provide a more detailed portrait of North Carolina's current broadband workforce, **Table 5** applies national estimates of the distribution of the key broadband occupations discussed in Section 2.3 across the six key broadband industries identified in Section 2.1. Owing to the nature of the data, these estimates should be treated as illustrative of the specific workforce requirements of individual industries. Consider how the broad telecommunications sector employs an estimated two-thirds of all telecommunications equipment installers and repairers, while nearly a third of all line installers are in the Power and Communication Line and Related Structures Construction industry.[23]

Table 5. Estimated Occupational Employment in Six Key Industries in the Broadband Sector, North Carolina, 2022

Sources: N.C. Department of Commerce: Labor and Economic Division, Occupational Employment and Wage Statistics Program, May 2022; and U.S. Bureau of Labor Statistics: Employment Projections Program: National Employment Matrix: Occupations, 2021.

				Power and Communication Line and Related Structure Construction Industry		Fiber Optic Cable Manufacturing Industry		All Other Misc. Electrical Equipment and Component Manufacturing Industry		Cable and Other Subscription Programming Industry (2017 NAICS category)		Wired & Wireless Telecommunications Carriers Industry	
Major SOC Group	SOC Code	SOC Detailed Occupational Title	Estimated Occupational Employment	Share of Occupation	Estimated Occupational Employment	Share of Occupation	Estimated Occupational Employment	Share of Occupation	Estimated Occupational Employment	Share of Occupation	Estimated Occupational Employment	Share of Occupation	Estimated Occupational Employment
Management	11-9021	Construction Managers	20,660	1.5%	310	0.0%	0	0.0%	0	0.0%	0	0.3%	62
	11-9179	Personal Services Manager, All Others	##	##	##	##	##	##	##	##	##	##	##
Business and Financial Operations	13-1198	Project Management Specialists and Business Operations Specialists (All Others)	32,490	0.3%	97	0.1%	32	0.1%	32	0.1%	32	1.1%	357
Computer and Mathematical Operations	15-1253	Software Developers and Software Quality Assurance Analysts and Testers	8,210	0.0%	0	0.0%	0	0.0%	0	0.2%	16	1.6%	131
Architecture and Engineering	**17-2072**	**Electronic Engineers (except computer)**	**1,830**	**0.3%**	**5**	**0.4%**	**7**	**0.4%**	**7**	**0.1%**	**2**	**18.0%**	**329**
Sales and Related	41-3091	Sales Representatives of Services (except advertising, insurance, financial services, and travel)	33,480	0.4%	134	0.0%	0	0.0%	0	0.3%	100	6.7%	2,243
Office and Administrative Support	43-4051	Customer Service Representatives	89,500	0.0%	0	0.1%	90	0.1%	90	0.1%	90	1.8%	1,611
Construction and Extraction	47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	30,290	2.1%	636	0.0%	0	0.0%	0	0.0%	0	0.1%	30
	47-2061	Construction Laborers	31,600	2.5%	790	0.0%	0	0.0%	0	0.0%	0	0.1%	32
	47-2073	Operating Engineers and Other Construction Equipment Operators	14,190	3.8%	539	0.0%	0	0.0%	0	0.0%	0	0.2%	28
	47-2111	Electricians	22,640	1.2%	272	0.1%	23	0.1%	23	0.0%	0	0.0%	0
Installation, Maintenance, and Repair	49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	19,110	2.4%	459	0.1%	19	0.1%	19	0.1%	19	2.8%	535
	49-2021	**Radio, Cellular, and Tower Equipment Installers and Repairers**	**420**	**11.7%**	**49**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**31.6%**	**133**
	49-2022	**Telecommunications Equipment Installers and Repairers (except line installers)**	**5,090**	**0.4%**	**20**	**0.0%**	**0**	**0.0%**	**0**	**2.0%**	**102**	**65.6%**	**3,339**
	49-9051	**Electrical Power-Line Installers and Repairers**	**5,630**	**30.8%**	**1,734**	**0.0%**	**0**	**0.0%**	**0**	**0.0%**	**0**	**0.2%**	**11**
	49-9052	**Telecommunications Line Installers and Repairers**	**3,070**	**14.7%**	**451**	**0.0%**	**0**	**0.0%**	**0**	**1.2%**	**37**	**59.6%**	**1,830**
	49-9098	**Helpers, Installation, Maintenance and Repair Workers**	**3,890**	**1.3%**	**51**	**0.6%**	**23**	**0.6%**	**23**	**0.0%**	**0**	**0.3%**	**12**
Production	51-2021	Coil Winders, Tapers, and Finishers	320	0.0%	0	4.5%	14	4.5%	14	0.0%	0	0.0%	0
	51-2028	Electrical, Electronics, & Electromechanical Assemblers (except coli winders, tapers, and finishers)	8,050	0.0%	0	10.1%	813	10.1%	813	0.0%	0	0.1%	8
	51-2090	Miscellaneous Assemblers and	52,590	0.0%	0	1.1%	578	1.1%	578	0.0%	0	0.0%	0

Notes: 1) Detailed occupations in **SHADED BOLD** are highly critical (specialized) to broadband expansion; 2) " ##" denotes a category with missing or suppressed data; 3) the employment estimates subject to statistical error; 4) the National Employment Matrix uses the 2017 version of the NAICS, not the 2022 one; and 5) disaggregated data are not available for wired and wireless telecommunications carriers, so the categories are combined.

Returning to the broadest view of broadband-related occupations, North Carolina performs reasonably close to, if not better, than what would be expected relative to the nation in the key broad-band related occupational categories identified previously, with the notable exception of electronic engineers. A sizable infusion of federal funds through the BEAD program, however, likely will alter the demand for broadband-relevant workers. Absent deliberate workforce policy interventions mindful of the interaction of BEAD Program funding with the demographic composition of the relevant workforce, employers in the broadband sector may confront shortages of appropriately qualified workers, especially in critical occupations.

3. Job Trends, Qualifications, and Quality in the Broadband Sector

This section of the labor analysis considers the mix of job trends, qualifications, and quality in the broadband sector. Every occupation has certain qualifications that a person must possess to perform the job. Depending on the field, a person may acquire needed skills through formal education, on-the-job training, or the completion of a registered apprenticeship. (Certain fields may require an occupational license, too.) Employers, meanwhile, enjoy latitude in setting hiring requirements. When there is an abundance of a certain type of qualified worker, an employer may be highly selective when hiring, but when the supply is scarce, an employer may need to show flexibility and invest more directly in workforce development. Either way, the quality of a job stems from the combination of demand for a particular type of worker, the supply of such workers, the job qualifications, and the practices of the industry and firm.

3.1 Job Trends in North Carolina's Broadband Sector

Employment growth in North Carolina's broadband sector can be measured in relation to both industrial employment and occupational employment. Viewed through either lens, the overall sector has maintained a fairly stable size in recent years.

Table 6 presents state-level trends in industrial employment for the six critical industries in the broadband sector identified in Section 2.1 between 2017 and 2021, the latest year with complete data.[24] Overall employment in the sector fell by 1.3% over that five-year period, declining to 36,384 payroll jobs from 36,853 payroll jobs. Wired Telecommunications Carriers added the most payroll jobs in absolute terms (+1,980), while Fiber Optic Cable Manufacturing grew the most in relative terms (+33%). The Power and Communication Line and Related Construction industry also grew, with the combined growth in this and the two aforementioned industries mostly offsetting declines among Wireless Telecommunications Carriers and Cable and Other Subscription Programming establishments.

Table 6. Changes in Payroll Employment Levels in Key Industries in the Broadband Sector, North Carolina, 2017-2021
Source: N.C. Department of Commerce: Labor and Economic Analysis Division, Quarterly Census of Employment and Wagers, Average Annual Values for 2017 and 2021.

Six-Digit NAICS Code (2017)	NAICS Industry Title (2017)	Average Annual Payroll Employment (2017)	Average Annual Payroll Employment (2021)	Numerical Change (2017-2021)	Percentage Change (2017-2021)	Annualized Rate of Change
237130	Power and Communication Line and Related Structures Construction	9,246	9,875	629	6.8%	1.4%
335921	Fiber Optic Cable Manufacturing	2,479	3,288	809	32.6%	6.5%
335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing	784	668	-116	-14.8%	-3.0%
515210	Cable and Other Subscription Programming	2,502	640	-1,862	-74.4%	-14.9%
517311	Wired Telecommunications Carriers	16,532	18,512	1,980	12.0%	2.4%
517312	Wireless Telecommunications Carriers	5,310	3,401	-1,909	-36.0%	-7.2%
	Sector Total	36,853	36,384	-469	-1.3%	-0.3%

Note: This table is based on the 2017 version of the NAICS; the main change is that Cable and Other Subscription Programming industry is part of the broader Media Streaming Distribution Services industry as of 2022.

Table 7 presents statewide trends in occupational employment for the 20 essential broadband occupations introduced in Section 2.3 between 2018 and 2022.[25] (Due to methodological changes and challenges, these estimates should be viewed illustratively.) Total employment in these occupations rose by 8% over that period, rising to 383,060 from 346,143 positions. In general, the greatest numerical increases occurred in construction and extraction occupations. While the specialized occupations in the installation, maintenance, and repair category (marked in **shaded bold**) also grew, they did so more modestly and from a lower base.

Table 7. Changes in Occupational Employment Levels in 20 Detailed Occupations Highly Impacted by Federal Investments in Broadband Expansion (Listed by SOC Code), North Carolina, All Industries, 2018-2022

Source: N.C. Department of Commerce: Labor and Economic Division, Occupational Employment and Wage Statistics Program, May 2022; and US Bureau of Labor Statistics, Occupational Employment, and Wages Statistics Program: Research Estimates by State and Industry, May 2018.

Major SOC Group	SOC Code	SOC Detailed Occupational Title	Estimated Employment (2018)	Estimated Employment (2022)	Numerical Change (2018-2022)	Percentage Change (2017-2022)	Annualized Rate of Change
Management	11-9021	Construction Managers	19,700	20,660	960	4.9%	1.0%
	11-9179	Personal Services Manager, All Others	##	##	##	##	##
Business and Financial Operations	13-1198	Project Management Specialists and Business Operations Specialists (All	27,110	32,490	5,380	19.8%	4.0%
Computer and Mathematical Operations	15-1253	Software Developers and Software Quality Assurance Analysts and Testers	##	8,210	##	##	##
Architecture and Engineering	**17-2072**	**Electronic Engineers (except computer)**	**1,980**	**1,830**	**-150**	**-7.6%**	**-1.5%**
Sales and Related	41-3091	Sales Representatives of Services (except advertising, insurance, financial services, and travel)	32,800	33,480	680	2.1%	##
Office and Administrative Support	43-4051	Customer Service Representatives	89,850	89,500	-350	-0.4%	-0.1%
Construction and Extraction	47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	25,720	30,290	4,570	17.8%	3.6%
	47-2061	Construction Laborers	25,230	31,600	6,370	25.2%	5.0%
	47-2073	Operating Engineers and Other Construction Equipment Operators	11,520	14,190	2,670	23.2%	4.6%
	47-2111	Electricians	16,190	22,640	6,450	39.8%	8.0%
Installation, Maintenance, and Repair	49-1011	First-Line Supervisors of Mechanics, Installers and Repairers	15,770	19,110	3,340	21.2%	4.2%
	49-2021	**Radio, Cellular, and Tower Equipment Installers and Repairers**	**##**	**420**	**##**	**##**	**##**
	49-2022	**Telecommunications Equipment Installers and Repairers (except line installers)**	**5,880**	**5,090**	**-790**	**-13.4%**	**-2.7%**
	49-9051	**Electrical Power-Line Installers and Repairers**	**4,600**	**5,630**	**1,030**	**22.4%**	**4.5%**
	49-9052	**Telecommunications Line Installers and Repairers**	**3,010**	**3,070**	**60**	**2.0%**	**0.4%**
	49-9098	**Helpers, Installation, Maintenance and Repair Workers**	**3,700**	**3,890**	**190**	**5.1%**	**1.0%**
Production	51-2021	Coil Winders, Tapers, and Finishers	750	320	-430	-57.3%	-11.5%
	51-2028	Electrical, Electronics, & Electromechanical Assemblers (except coli winders, tapers, and finishers)	9,020	8,050	-970	-10.8%	-2.2%
	51-2090	Miscellaneous Assemblers and Fabricators	53,313	52,590	-723	-1.4%	-0.3%
		Total	346,143	383,060	28,287	8.2%	1.6%

Notes: 1) Detailed occupations in **SHADED BOLD** are highly critical (specialized) to broadband expansion; 2) " ##" denotes a category with missing or suppressed data; 3) the employment values are estimates subject to statistical error; and 4) due to methodological changes, the estimates for the two years are not directly comparable and so be treated as illustrative, not definitive.

Determining the actual demand for broadband-critical occupations at a given moment in time is difficult, as there is no uniform recruitment process for employers to use. Firms differ greatly in what they call jobs, the qualifications they will accept, and their recruitment processes. For perspective, **Table 8** lists the number of job postings (de-duplicated) in the 20 key broadband-related occupations featured in this labor analysis added to the *NCWorks Online* database between early May and early June of 2023.[26] Some 600 relevant job postings were uploaded over that time period. The greatest number of postings was for customer service representatives (112), followed by construction managers (58); operating engineers and other construction

equipment operators (51); and first-line supervisors of mechanics, installers, and repairers. For the six occupations considered the most specialized to broadband expansion (marked in **shaded bold**), there were 86 combined postings, with the greatest number for helpers-installation, maintenance, and repair workers (34), followed by electronic engineers (15).

Table 8. New Postings for Jobs in 20 Detailed Occupations Highly Impacted by Federal Investments in Broadband Expansion (Listed by SOC Code), North Carolina, May-June, 2023

Source: N.C. Department of Commerce: Labor and Economic Division, Occupational Employment and Wage Statistics Program, May 2022; and U.S. Bureau of Labor Statistics, Occupational Employment, and Wages Statistics Program: Research Estimates by State and Industry, May 2018.

Major SOC Group	SOC Code	SOC Detailed Occupational Title	Number of Job Postings	Share of Total
Management	11-9021	Construction Managers	58	9.7%
	11-9179	Personal Services Manager, All Others	1	0.2%
Business and Financial Operations	13-1198	Project Management Specialists and Business Operations Specialists (All Others)	37	6.2%
Computer and Mathematical Operations	15-1253	Software Developers and Software Quality Assurance Analysts and Testers	3	0.5%
Architecture and	**17-2072**	**Electronic Engineers (except computer)**	**15**	**2.5%**
Sales and Related	41-3091	Sales Representatives of Services (except advertising, insurance, financial services, and travel)	45	7.5%
Office and Administrative Support	43-4051	Customer Service Representatives	112	18.7%
Construction and Extraction	47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	54	9.0%
	47-2061	Construction Laborers	41	6.8%
	47-2073	Operating Engineers and Other Construction Equipment Operators	51	8.5%
	47-2111	Electricians	11	1.8%
Installation, Maintenance, and Repair	49-1011	First-Line Supervisors of Mechanics, Installers and Repairers	48	8.0%
	49-2021	**Radio, Cellular, and Tower Equipment Installers and Repairers**	**4**	**0.7%**
	49-2022	**Telecommunications Equipment Installers and Repairers (except line installers)**	**13**	**2.2%**
	49-9051	**Electrical Power-Line Installers and Repairers**	**11**	**1.8%**
	49-9052	**Telecommunications Line Installers and Repairers**	**9**	**1.5%**
	49-9098	**Helpers, Installation, Maintenance and Repair Workers**	**34**	**5.7%**
Production	51-2021	Coil Winders, Tapers, and Finishers	0	0.0%
	51-2028	Electrical, Electronics, & Electromechanical Assemblers (except coli winders, tapers, and finishers)	9	1.5%
	51-2090	Miscellaneous Assemblers and Fabricators	44	7.3%
		Total	600	100.0%

Notes: 1) Detailed occupations in **SHADED BOLD** are highly critical (specialized) to broadband expansion; 2) posting information has been de-duplicated to avoid double counting " ##" denotes a category with missing or suppressed data; 3) the employment values are estimates subject to statistical error; and 4) due to methodological changes, the estimates for the two years are not directly comparable and so be treated as illustrative, not definitive.

3.2 Job Qualifications for North Carolina's Broadband Sector

Table 9 summarizes the qualifications needed to perform the 20 critical broadband-related occupations featured in this labor analysis.[27] With the exception of software developers and electronic engineers, none of the fields require a bachelor's degree for entry; instead, potential entrants need a high school diploma or some postsecondary vocational training of the type offered by two-year colleges. Many of those occupations have the potential to use registered apprenticeships as a way of cultivating workers with the requisite skills.

Table 9. Typical Educational Requirements and Related Fields for 20 Detailed Occupations Highly Impacted by Federal Investments in Broadband Expansion (Listed by SOC Code), United States, 2023

*Source: U.S. Department of Labor: Employment and Training Administration, O*NET Online, last updated May 23, 2023; https://www.onetonline.org.*

Major SOC Group	SOC Code	SOC Detailed Occupational Title	Typical Educational Requirement	Years of Preparation	Registered Apprenticeship Option	Five Most Closely Related Occupations
Management	11-9021	Construction Managers	Bachelor's Degree	2 to 4	No	Civil Engineering Technologists & Technicians; Civil Engineers; Construction and Building Inspectors; First-Line Supervisors of Construction Trade and Extraction Workers; Solar Energy Installation Managers
	11-9179	Personal Services Manager, All	##	##	##	##
Business and Financial Operations	13-1198	Project Management Specialists and Business Operations Specialists (All Others)	##	##	##	##
Computer and Mathematical Operations	15-1253	Software Developers and Software Quality Assurance Analysts and Testers	Bachelor's Degree	2 to 4	No	Computer Systems Analysts; Computer System Engineers/Architects; Penetration Testers; Software Developers; Validation Engineers
Architecture and Engineering	**17-2072**	**Electronic Engineers (except computer)**	**Bachelor's Degree**	**2 to 4**	**No**	**Computer Hardware Engineers; Electrical and Electronic Engineering Technologists and Technicians; Electrical Engineers; Mechatronics Engineers; Microsystems Engineers**
Sales and Related	41-3091	Sales Representatives of Services (except advertising, insurance, financial services, and travel)	High School Diploma	<1	Potentially	Advertising Sales Agents; Customer Service Representatives; New Account Clerks; Sales Managers; Telemarketers
Office and Administrative Support	43-4051	Customer Service Representatives	High School Diploma	<1	Potentially	Billing and Posting Clerks; Insurance Claims and Policy Processing Clerks; Receptionists and Information Clerks; Sales Representatives of Services (except advertising), insurance, financial services, and travel); Telemarketers
Construction and Extraction	47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	Postsecondary Vocational Training	1 to 2	Potentially	First-Line Supervisors of Helpers, Laborers, and Material Movers (Hand); First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers; First-Line Supervisors of Production and Operating Workers; Solar Energy Installation Managers
	47-2061	Construction Laborers	High School Diploma	<1	Potentially	Brickmasons and Blockmasons; Cement Masons and Concrete Finishers; Excavating and Loading Machine and Dragline Operators (Surface Mining); Paving, Surfacing, and Tamping Equipment Operators; Pipelayers

	47-2073	Operating Engineers and Other Construction Equipment Operators	High School Diploma	<1	Potentially	Continuous Mining Machine Operators; Excavating and Loading Machine and Dragline Operators (Surface Mining); Hoist and Winch Operators; Industrial Truck and Tractor Operators; Mobile Heavy Equipment Mechanics (except engineers)
	47-2111	Electricians	Postsecondary Vocational Training	1 to 2	Potentially	Electrical and Electronics Repairers (Powerhouse, Substation, and Relay); Electrical Power-Line Installers and Repairers; Helpers (electricians); Lighting Technicians; Plumbers, Pipefitters, and Steamfitters
Installation, Maintenance, and Repair	49-1011	First-Line Supervisors of Mechanics Installers and Repairers	Postsecondary Vocational Training	1 to 2	Potentially	First-Line Supervisors of Construction Trades and Extraction Workers; First-Line Supervisors of Helpers; Laborers, and Material Movers (Hand); First-Line Supervisors of Material-Moving Machine and Vehicle Operators; First-Line Supervisors of Passenger Attendants; First-Line Supervisors of Production and Operating Workers
	49-2021	**Radio, Cellular, and Tower Equipment Installers and Repairers**	**Postsecondary Vocational Training**	**1 to 2**	**Potentially**	**Audiovisual Equipment Installers and Repairers; Avionics Technicians; Electrical and Electronics Repairers (commercial and industrial equipment); Radio Frequency Identification Device Specialists; Telecommunications Equipment Installers and Repairers (except line installers)**
	49-2022	**Telecommunications Equipment Installers and Repairers (except line installers)**	**Postsecondary Vocational Training**	**1 to 2**	**Potentially**	**Audiovisual Equipment Installers and Repairers; Electrical and Electronics Repairers (commercial and industrial equipment); Power Distributors and Dispatchers; Radio, Cellular, and Tower Equipment Installers and Repairers; Telecommunications Line Installers and Repairers**
	49-9051	**Electrical Power-Line Installers and Repairers**	**High School Diploma**	**<1**	**Potentially**	**Electrical and Electronics Repairers (powerhouse, substation, and relay); Electricians; Helpers (electricians); Hoist and Winch Operators; Telecommunications Line Installers and Repairers**
	49-9052	**Telecommunications Line Installers and Repairers**	**High School Diploma**	**<1**	**Potentially**	**Audiovisual Equipment Installers and Repairers; Electrical and Electronics Repairers (transportation equipment); Electrical Power-Line Installers and Repairers; Radio, Cellular, and Tower Equipment Installers and Repairers; Telecommunications Equipment Installers and Repairers (except line installers)**
	49-9098	**Helpers, Installation, Maintenance and Repair Workers**	**High School Diploma**	**<1**	**Potentially**	**Helpers (carpenters); Helpers (electricians); Helpers (extraction workers); Helpers (pipelayers, plumbers, pipefitters, and steamfitters); Helpers (production workers)**
Production	51-2021	Coil Winders, Tapers, and Finishers	High School Diploma	<1	Potentially	Electrical and Electronic Equipment Assemblers; Extruding and Forming Machine Setters, Operators, and Tenders (synthetic and glass fibers); Grinding and Polishing Workers (hand); Lathe and Turning Machine Tool Setters, Operators, and Tenders (metal and plastic); Welding, Soldering, and Brazing Machine Setters, Operators, and Tenders
	51-2028	Electrical, Electronics, & Electromechanical Assemblers (except coli winders, tapers, and finishers)	High School Diploma	<1	Potentially	Aircraft Structure, Surfaces, Rigging, and Systems Assemblers; Electric Motor, Power Tool, and Related Repairers; Electromechanical Equipment Assemblers; Engine and Other Machine Assemblers; Industrial Machinery Mechanics
	51-2090	Miscellaneous Assemblers and Fabricators	##	##	##	##

Notes: 1) Detailed occupations in **SHADED BOLD** are highly critical (specialized) to broadband expansion; and 2) " ##" denotes a category with missing or no available data.

As noted previously, five of the most highly specialized occupations related to the broadband sector are installation, maintenance, and repair occupations (marked in **shaded bold** in **Table 9**). None of those five occupations requires a four-year degree, and all of them have potential apprenticeship opportunities associated with them.[28] And, as noted in the table's final column, many of these occupations are closely related to other ones, which suggests the possibility of transitioning workers in those occupations into the broadband sector, although care would be required so as not to disrupt other industries. Note, too, how several occupations on the overall list are supervisory ones, which potentially could be filled through internal career development among a firm's incumbent workforce. Given the importance of these occupations to broadband expansion and the nature of the jobs, they likely are well-suited to programmatic support from two-year colleges and the public workforce system.

3.3 Job Quality for Broadband-Related Jobs

The quality of a particular job reflects such factors as pay, benefits, and labor relations. Those factors, in turn, are influenced by occupational requirements, job responsibilities, supply and demand dynamics, industry patterns, labor relations, and firm-level practices. This section of the labor analysis considers, in turn, three aspects of job quality in the broadband sector: pay, benefits, and union density.

Table 10. Wage Distribution in in 20 Detailed Occupations Highly Impacted by Federal Investments in Broadband Expansion (Listed by SOC Code), North Carolina and United States, All Industries, May 2022

Sources: N.C. Department of Commerce: Labor and Economic Division, Occupational Employment and Wage Statistics Program, May 2022; and U.S. Bureau of Labor Statistical, Occupational Employment and Wage Statistics, May 2022.

			Hourly Wage						Annual Wage					
Major SOC Group	SOC Code	SOC Detailed Occupational Title	25th Percentile	Compared to Statewide Value	50th Percentile (Median)	Compared to Statewide Value	75th Percentile	Compared to Statewide	25th Percentile	Compared to Statewide Value	50th Percentile (Median)	Compared to Statewide Value	75th Percentile	Compared to Statewide Value
Management	11-9021	Construction Managers	$36.91	ñ	$47.39	ñ	$62.56	ñ	$76,780	ñ	$98,580	ñ	$130,130	ñ
			$37.96		*$48.79*		*$63.11*		*$78,950*		*$101,480*		*$131,280*	
	11-9179	Personal Services Manager, All Others	$21.08	ñ	$33.66	ñ	$37.32	ñ	$43,850	ñ	$70,010	ñ	$77,620	ñ
			$19.40		*$26.97*		*$34.30*		*$40,350*		*$56,090*		*$71,350*	
Business and Financial Operations	13-1198	Project Management Specialists and Business Operations Specialists (All Others)	$25.87	ñ	$32.87	ñ	$44.74	ñ	$53,820	ñ	$63,380	ñ	$93,070	ñ
			$26.31		*$36.53*		*$48.60*		*$54,720*		*$75,990*		*$101,090*	
Computer and Mathematical	15-1253	Software Developers and Software Quality Assurance	$34.35	ñ	$46.97	ñ	$55.20	ñ	$71,440	ñ	$97,700	ñ	$114,810	ñ
			$36.40		*$47.89*		*$61.38*		*$75,710*		*$99,620*		*$127,660*	
Architecture and Engineering	**17-2072**	**Electronic Engineers (except computer)**	**$39.35**	**ñ**	**$47.22**	**ñ**	**$58.51**	**ñ**	**$81,850**	**ñ**	**$98,220**	**ñ**	**$121,710**	**ñ**
			$41.44		***$52.00***		***$66.28***		***$86,190***		***$108,170***		***$137,870***	
Sales & Related	41-3091	Sales Representatives of Services (except advertising, insurance, financial services, and travel)	$21.41	ñ	$29.47	ñ	$44.48	ñ	$44,530	ñ	$61,300	ñ	$92,520	ñ
			$21.77		*$30.00*		*$45.28*		*$45,280*		*$62,400*		*$94,170*	
Office and Administrative	43-4051	Customer Service Representatives	$14.39	ò	$17.42	ò	$21.85	ò	$29,930	ò	$36,230	ò	$45,460	ò
			$15.16		*$18.16*		*$22.60*		*$31,520*		*$37,780*		*$47,010*	
Construction and Extraction	47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	$24.84	ñ	$30.03	ñ	$37.38	ñ	$51,660	ñ	$62,450	ñ	$77,750	ñ
			$28.41		*$35.62*		*$45.10*		*$59,100*		*$74,080*		*$93,800*	
	47-2061	Construction Laborers	$14.82	ñ	$17.46	ò	$18.99	ò	$30,830	ñ	$36,310	ò	$39,490	ò
			$16.99		*$19.59*		*$24.61*		*$35,530*		*$40,750*		*$51,200*	
	47-2073	Operating Engineers and Other Construction Equipment Operators	$18.51	ñ	$21.82	ñ	$23.52	ò	$38,490	ñ	$45,380	ñ	$48,930	ò
			$21.07		*$24.73*		*$32.85*		*$43,820*		*$51,430*		*$68,330*	
	47-2111	Electricians	$21.23	ñ	$23.57	ñ	$27.82	ò	$44,150	ñ	$49,020	ñ	$57,860	ò
			$22.69		*$28.96*		*$37.60*		*$47,200*		*$60,240*		*$78,210*	
Installation, Maintenance, and Repair	49-1011	First-Line Supervisors of Mechanics Installers and Repairers	$26.41	ñ	$32.88	ñ	$40.64	ñ	$54,930	ñ	$68,390	ñ	$84,520	ñ
			$27.29		*$35.16*		*$44.50*		*$56,760*		*$73,140*		*$92,560*	
	49-2021	**Radio, Cellular, and Tower Equipment Installers and Repairers**	**$22.52**	**ñ**	**$27.00**	**ñ**	**$29.07**	**ò**	**$46,840**	**ñ**	**$56,160**	**ñ**	**$60,470**	**ò**

			$22.31		*$28.71*		*$37.14*		*$46,400*		*$59,720*		*$77,260*	
	49-2022	**Telecommunications Equipment Installers and Repairers (except line installers)**	**$22.49**	**ñ**	**$28.40**	**ñ**	**$33.54**	**ñ**	**$46,790**	**ñ**	**$59,080**	**ñ**	**$73,930**	**ñ**
			$22.45		*$28.83*		*$36.80*		*$46,690*		*$59,960*		*$76,550*	
	49-9051	**Electrical Power-Line Installers and Repairers**	**$24.93**	**ñ**	**$31.81**	**ñ**	**$39.39**	**ñ**	**$51,850**	**ñ**	**$66,160**	**ñ**	**$81,930**	**ñ**
			$29.90		*$39.59*		*$49.07*		*$62,190*		*$82,340*		*$102,070*	
	49-9052	**Telecommunications Line Installers and Repairers**	**$19.62**	**ñ**	**$24.24**	**ñ**	**$31.22**	**ñ**	**$40,810**	**ñ**	**$50,420**	**ñ**	**$64,940**	**ñ**
			$22.45		*$28.83*		*$36.80*		*$46,690*		*$59,960*		*$76,550*	
	49-9098	**Helpers, Installation, Maintenance and Repair Workers**	**$13.48**	**ò**	**$15.00**	**ò**	**$18.17**	**ò**	**$28,040**	**ò**	**$31,200**	**ò**	**$37,780**	**ò**
			$14.35		*$16.88*		*$19.80*		*$29,850*		*$35,100*		*$41,180*	
Production	51-2021	Coil Winders, Tapers, and Finishers	$17.80	ñ	$24.97	ñ	$30.83	ñ	$37,020	ñ	$51,940	ñ	$64,120	ñ
			$17.64		*$20.75*		*$24.40*		*$36,700*		*$43,160*		*$50,750*	
	51-2028	Electrical, Electronics, & Electromechanical Assemblers (except coli winders, tapers, and finishers)	$16.60	ñ	$18.76	ò	$22.65	ò	$34,530	ñ	$39,020	ò	$47,110	ò
			$16.46		*$18.55*		*$22.61*		*$34,230*		*$38,580*		*$47,020*	
	51-2090	Miscellaneous Assemblers and Fabricators	$14.49	ñ	$17.02	ò	$20.46	ò	$30,130	ñ	$35,390	ò	$42,560	ò
			$15.26		*$17.93*		*$22.01*		*$31,750*		*$37,280*		*$45,780*	
		Total: All Occupations	$14.42	##	$20.10	##	$30.74	##	$29,990	##	$41,810	##	$63,940	##
			$16.03		*$22.26*		*$35.32*		*$33,330*		*$46,310*		*$73,460*	

Notes: 1) Detailed occupations in **SHADED BOLD** are highly critical (specialized) to broadband expansion; 2) values in *ITALICS* are national values; and 3) the values are estimates subject to statistical error.

Table 10 shows the wage distribution for the 20 critical broadband-related occupations featured throughout this labor analysis.[29] For each occupation, the table presents the 25th-percentile value, the 50th-percentile value (median), and the 75th-percentile value recorded in North Carolina in May 2022, the last year with complete data. Data are presented for hourly and annual wages, with the second row in each category showing the corresponding values for the United States as a whole. And each state-specific value is compared to the corresponding overall value in North Carolina.

Median hourly wages for the 20 critical broadband-related occupations in North Carolina generally are higher than the overall statewide value of $20.10.[30] Median wage exceeded the statewide value in 15 of the 20 occupations. The occupations that paid less were generally those that do not require formal educational qualifications beyond a high school diploma (e.g., customer service representatives, construction laborers, helpers). In contrast, five of the six most specialized broadband occupations (marked in **shaded bold**) paid above-median wages. For example, the median hourly wage for electrical power-line installers and repairers was $31.81 per hour, an amount 58% greater than the corresponding statewide figure. The combination of above-median wages and the ability to enter an occupation without a four-year degree points to these fields as sources of well-paying jobs open to a diverse set of workers.

Highly detailed, state-specific data on employment benefits unfortunately are unavailable. That said, there are some clear patterns: full-time, unionized, higher-paid production and managerial employees of large firms are more apt to receive key benefits than part-time, nonunionized, lower-paid service workers at smaller firms.[31] Consider the category of installation, maintenance, and repair occupations, which encompasses six of the 20 primary broadband-related occupations featured in this labor analysis, including five of the most specialized ones. Nationally, 74% of those workers had access to retirement benefits in 2022. Some 78% of such workers also had access to medical care benefits, with the typical employer covering about 80% of premium costs. Over 90% of such workers received paid vacation and holiday time, although just 71% had paid sick leave.

One factor that differentiates North Carolina from other states, including many populous ones, is its low rate of unionization. In 2022, just 3% of all North Carolina workers belonged to a union, a share lower than that in every state but South Carolina.[32] Viewed through an industrial lens, an estimated 12% of all workers in the construction sector (nationally) belonged to a union in 2022, as did 8% of all workers in the telecommunications sector and 8% of all employees in the manufacturing sector. Given the exceptionally low rates of unionization in North Carolina, the corresponding shares in its broadband-related industries likely are lower than is the case nationally.

4. Demographic Characteristics of the Broadband Workforce

An infusion of federal broadband money into North Carolina via federal programs likely will create new demand for broadband-related workers and shift the related occupations onto a growth trajectory different from the one described in Section 3.1. This raises important questions about not just from where the workers will come, but also who those workers might be. This section of the labor analysis therefore compares certain key demographic characteristics (e.g., gender, race/ethnicity, and age) of North Carolina's current broadband-related workforce to those of the potential workforce, especially unemployed individuals.

4.1 Demographic Characteristics of North Carolina's Broadband Workforce

Compared to North Carolina's overall workforce, the state's existing broadband workforce is disproportionately dominated by older, male workers (especially the workforce in critical broadband occupations). For instance, in the combined Wired and Wireless Telecommunications industry, male workers account for two-thirds of the workforce; meanwhile, only 5 percent of the workforce is under the age of 25. (Notably, this sector has a much higher share of workers who identify as Black or African American than is typical in North Carolina, which suggests a potential strength to be nurtured.) Meeting future workforce demand in an inclusive way will require conscious efforts to attract women, young adults, and persons from diverse racial groups into the larger broadband sector.

Table 11 shows the distribution of the current employed broadband workforce in relation to three demographic traits—biological sex, age, and race and ethnicity—as of mid-2022, the most recent period with data.[33] Data are shown for employment in the six key broadband industries introduced in Section 2.1, although data limitations limit the analysis to the four-digit NAICS level (denoting an industry group) rather than the six-digit level (detailed industry). As a result, data for Fiber Optic Cable Manufacturing and All Other Miscellaneous Electrical Equipment and Component Manufacturing are subsumed into larger categories, as are data for Wired and Wireless Telecommunications Carriers.

Table 11. Selected Demographic Traits of Workforce in Key Industries in the Broadband Sector, North Carolina, 2022.q3
Source: US Census Bureau, Longitudinal Employer-Household Dynamics Program, Quarterly Workforce Indicators, 2022.q3.

		Sex		Age				Race and Ethnicity						
Four-Digit NAICS Code (2017)	NAICS Industry Title (2017)	Share Male	Share Female	Share Under Age 25	Share Ages 25-54	Share Ages 55-64	Share Ages 65+	Share Non-Hispanic White Persons	Share Black/ African-American Persons	Share Native American Persons	Share Asian Persons	Share Native Hawaiian/ Pacific Islander Persons	Share Multiracial Persons	Share Hispanic/ Latino Persons
2371	Utility System Construction	85.1%	14.9%	15.1%	64.3%	14.4%	6.3%	73.1%	9.8%	1.6%	1.2%	0.1%	1.2%	12.9%
3359	Other Electrical Equipment and Component Manufacturing	69.1%	30.9%	6.5%	62.4%	26.1%	5.0%	66.5%	19.3%	0.3%	7.4%	0.1%	1.0%	5.4%
5171	Wired and Wireless Telecommunications Carriers (except satellite)	63.9%	36.1%	5.2%	75.4%	16.4%	3.0%	58.7%	30.0%	0.5%	3.4%	0.1%	1.5%	5.9%
	All Industries in North Carolina	49.3%	50.7%	13.8%	62.4%	16.9%	6.9%	63.7%	22.6%	0.8%	3.5%	0.1%	1.5%	7.8%

Notes: 1) Not all categories may sum to 100% due to rounding; 2) Due to limits in data availability, estimates are not available below the 4-digit NAICS level; 3) NAICS code 3359 encompasses Fiber Optic Cable Manufacturing and All Other Miscellaneous Electrical Equipment and Component Manufacturing; 4) NAICS code 5171 encompasses Wired Telecommunications Carriers and Wireless Telecommunications Carriers; and 5) No data are available for the Cable and Other Subscription Programming Industry.

Compared to the state as a whole, the key broadband industries considered in this labor analysis rely on workforce comprised largely of male workers.[34] In all three categories, male workers account for at least 64% of the workforce, with that share rising to 85% in the Utility System Construction industry. In contrast, male workers account for 49% of all employed persons in the state.

The existing broadband workforce also skews older in age than the overall North Carolina workforce.[35] In the Other Electrical Equipment and Component Manufacturing industry, nearly one-third of the incumbent workforce is at least 55 years old, versus 24% of all employed North Carolinians. In all three key industrial groupings, at least 19% of the incumbent workforce either is of traditional retirement age or will reach that age by 2032. Interestingly, the Wired and Wireless Telecommunications Carriers industry has the youngest workforce of the three categories analyzed, with three-quarters of the current workforce in the prime-age working years of 25-54 (versus a statewide figure of 62%); however, that same industry has comparatively fewer workers under the ages of 25, so without bringing more young people into the field, the existing workforce will gradually age.

Finally, the existing broadband workforce demonstrates distinct patterns in regard to its racial and ethnic composition.[36] Compared to the state as a whole, the Utility System Construction and Other Electrical Equipment and Component Manufacturing industries employ disproportionally high shares of non-Hispanic White workers (73% and 67%, respectively). Hispanic persons, interestingly, account for 13% of the workforce in the Utility System Construction industry, versus 8% of the statewide total. Notably, 30% of the persons in the broad Telecommunications sector identify as Black or African American—a share higher than the statewide rate of 23%.

Each specific industry relies on a particular mix of occupations to produce its goods and services, as discussed previously. Specific occupations, in turn, tend to attract workers with certain demographic traits. Those patterns rarely, if ever, reflect any rational relationship between a given demographic trait and the ability of a person who possesses that trait to perform the job; instead, the patterns too often result from social norms and biases that lead to occupational segregation and stratification. Setting aside those biases can bring a potentially larger pool of potentially successful broadband-sector workers into view.

Consider the six highly specialized broadband-related occupations considered in this labor analysis (those marked in **shaded bold** on **Table 3** and others). Five of those six occupations

fall into the larger category of installation, maintenance, and repair occupations. This is a category in which older, non-Hispanic white, male workers predominate. From 2017 to 2021, on average, male workers accounted for 95% of all employed persons in construction, extraction, and maintenance occupations in North Carolina; furthermore, non-Hispanic white male workers contributed 62% of the overall total.[37] Similar patterns apply in the other key broadband-related occupational categories considered throughout this labor analysis. Male persons, for example, accounted, on average, for 65% of employed production workers, 79% of the employed computer and mathematical operations workforce, and 84% of the employed architecture and engineering workforce. Female persons, in contrast, constituted 76% of the employed office and administrative support workforce, on average.

4.2 Demographic Characteristics of North Carolina's Potential Broadband Workforce

One way to increase the size of North Carolina's broadband-related workforce moving forward is by considering workers with demographic characteristics different from those possessed by the incumbent workforce. And one source of workers with more diverse characteristics is the pool of North Carolinians who are jobless and actively seeking work.

The number of unemployed persons in North Carolina in 2021 averaged 226,00 which translated into an average statewide unemployment rate of 4.6%.[38] As shown in **Table 12**, unemployment rates were higher for male workers than female ones, younger workers than older ones, Black/African American workers and Hispanic workers than white ones, and single female parents than married ones. While the overall statewide rate was low, the higher rates among particular populations—including many that long have been economically marginalized—point to potential workers who potentially could fill broadband-related jobs, though they may need assistance in acquiring the requisite occupational skills.

As noted in Section 3.1, most all of the occupations critical to the broadband sector do not require baccalaureate degrees; instead, potential entrants need a high school diploma or some postsecondary vocational training offered by two-year colleges or through registered apprenticeships. Target populations for recruitment into the industry would include those who possess a high school diploma or some college, populations that, as shown in **Table 12**, tend to have relatively higher unemployment rates. Even persons who have not completed high school could be brought into the sector in an occupation like a laborer and then move into other occupations through the provision of workplace training, apprenticeships, or sectoral collaborations. Such actions would not only foster a potential pipeline of needed workers into industry, but also connect individuals to better paying job opportunities and career paths.

Table 12. Unemployment Rates among Workers with Selected Demographic Characteristics, North Carolina, Annual Average Value, 2021
Source: U.S. Bureau of Labor Statistics, Geographic Profile of Employment and Unemployment, 2021.

	Demographic Characteristic	Estimated Number of Persons	Estimated Unemployment Rate	Error Range of Unemployment Rate
Persons Ages 16+	All Persons	226,000	4.6%	4.0-5.2
	Male	122,000	4.8%	4.0-5.6
	Female	103,000	4.4%	3.6 -5.2
	All White Persons	132,000	3.7%	3.1-4.3
	Male	74,000	3.9%	3.0-4.8
	Female	57,000	3.5%	2.6-4.4
	All Black or African-American Persons	80,000	7.7%	6.0-9.4
	Male	40,000	8.6%	5.9-11.3
	Female	40,000	7.1%	4.9-9.3
	All Asian Persons	4,000	2.0%	0.4-3.6
	Male	##	##	##
	Female	##	##	##
	All Hispanic or Latino Persons	31,000	5.6%	3.8-7.4
	Male	16,000	4.7%	2.6-8.8
	Female	15,000	6.9%	3.7-10.1
	All Persons Ages 16-19	31,000	9.3%	5.0-13.6
	Married Men, Spouse Present	26,000	2.0%	1.3-2.7
	Married Women, Spouse Present	35,000	3.1%	2.1-4.1
	Women who Maintain Families	19,000	5.3%	3.0-7.6
Persons Ages 25+	Persons with Less than a High School Diploma	19,000	6.4%	##
	Persons with High School Credential, No College	61,000	5.5%	##
	Persons with Some College or Associate's Degree	46,000	4.3%	##
	Persons with Bachelor's Degree or Higher	50,000	2.7%	##

Notes: 1) Not all categories may sum due to rounding; 2) due to limits in data availability, estimates are not available for racial and ethnic groups other than the ones shown; and 3) a "##" denotes missing, unavailable, or unpublished data.

5. Employment Projections for North Carolina's Broadband Sector

Projecting industrial and occupational growth is a highly speculative exercise. It is difficult to realistically model the complexity of any given industry, its interconnections to other industries, and its impact on a larger national or regional economy. To reduce complexity, common models rely on assumptions (e.g., full employment, uniform production, instantaneous response) that can border on the unrealistic and break down entirely in the face of unexpected changes or shocks (e.g., a global pandemic). Nevertheless, projections can provide general guideposts for business, educational, and civic leaders. This section of the labor analysis reviews current projections for growth in the broadband workforce absent any new federal funds (i.e., BEAD Program) and future projections reflective of BEAD Program funds and other federal monies for expanding high-speed internet available to North Carolina under the American Rescue Plan.

5.1 Baseline Projections: Industry, Occupation, and Openings Absent BEAD Program

Employment projections for North Carolina's broadband sector can be viewed in relation to industrial employment, occupational employment, and job openings. While projections exist for different periods, short-term ones generally will be more reliable than long-term ones.

Table 13 presents state-specific industrial projections for the broadband-related industries considered throughout this labor analysis for two periods of time: 2022-2024 and 2021-2030.[39]

Owing to data limitations, published projections exist only at the three-digit NAICS level (denoting an industry subsector), not the six-digit level (detailed industry). Data for Power and Communication Line and Related Structures Construction, consequently, is subsumed under the larger Heavy and Civil Engineering Construction subsector, just as Fiber Optic Cable Manufacturing and All Other Miscellaneous Electrical Equipment and Component Manufacturing are subsumed into the larger Electrical Equipment, Appliance, and Component Manufacturing subsector; similarly, data for Wired and Wireless Telecommunications Carriers fall under the larger Telecommunications subsector.

Table 13. Projected Changes in Industrial Employment in Key Industries in the Broadband Sector, North Carolina, 2022-2024 and 2021-2030
Source: N.C. Department of Commerce: Labor and Economic Analysis Division, Employment Projections., 2022-2024 and 2021-2030.

Panel A. Short-Term Projections, 2022-2024

NAICS Code (3-Digit)	NAICS Title	Estimated Employment (2022)	Estimated Employment (2024)	Numerical Change (2022-2024)	Percentage Change (2022-2024)	Annualized Rate of Change
237000	Heavy and Civil Engineering Construction	35,008	36,891	1,883	5.4%	2.7%
335000	Electrical Equipment, Appliance, and Component Manufacturing	21,564	21,564	0	0.0%	0.0%
515000	Broadcasting (except Internet)	5,549	5,549	0	0.0%	0.0%
517000	Telecommunications	23,913	23,389	-524	-2.2%	-1.1%
	Sector Total	*86,034*	*87,393*	*1,359*	*1.6%*	*0.8%*
	Statewide Total	5,026,613	5,249,706	223,093	4.4%	2.2%

Panel B. Long-Term Projections, 2021-2030

NAICS Code (3-Digit)	NAICS Title	Estimated Employment (2021)	Estimated Employment (2030)	Numerical Change (2021-2030)	Percentage Change (2021-2030)	Annualized Rate of Change
237000	Heavy and Civil Engineering Construction	34,677	38,777	4,100	11.8%	1.3%
335000	Electrical Equipment, Appliance, and Component Manufacturing	21,964	23,858	1,894	8.6%	1.0%
515000	Broadcasting (except Internet)	5,852	6,402	550	9.4%	1.0%
517000	Telecommunications	25,674	27,159	1,485	5.8%	0.6%
	Sector Total	*88,167*	*96,196*	*8,029*	*9.1%*	*1.0%*
	Statewide Total	4,902,016	5,347,745	445,729	9.1%	1.0%

In the short term, absent any external changes like new federal funding (**Panel A** in **Table 13**), North Carolina's broadband-related industries are projected to grow modestly between 2022 and 2024, collectively growing by just 1,360 payroll positions (+2%), with all of the growth projected to occur in the Heavy and Civil Engineering Construction subsector.[40] In the long term (**Panel B**), North Carolina's broadband-related industries are projected to add 8,030 payroll positions (+9%) between 2021 and 2030, with growth again led by the Heavy and Civil Engineering subsector. In the short-term scenario, North Carolina's broadband-related industries are projected to grow more slowly than the state as a whole (2% versus 4%), while in the long-term scenario, broadband-related industries are projected to grow at the same rate as the overall economy (9% for both).

Table 14, presents state-specific occupational projections for the broadband-related occupations considered throughout this labor analysis for two periods of time: 2022-2024 and 2021-2030.[41] In the short term, absent external changes like federal funding (**Panel A**), North Carolina's broadband-related occupations are projected to grow modestly between 2022 and 2024, collectively gaining 5,760 positions (+1%), with 10% of the total growth occurring among the six highly specialized broadband occupations discussed throughout this labor analysis (marked in shaded bold). In the long term (**Panel B**), North Carolina's broadband-related industries are projected to add 26,620 payroll positions (+7%) between 2021 and 2030, with 10% of the growth occurring in the six most highly specialized occupations. In the short-term scenario, North Carolina's broadband-related occupations are projected to grow more slowly than the state as a whole (1% versus 4%) The same trend is in the long-term data with these occupations forecast to grow by 7% versus 9% for the state.

Table 14. Projected Changes in Occupational Employment in Key Occupations in the Broadband Sector, North Carolina, 2022-2024 and 2021-2030
Source: N.C. Department of Commerce: Labor and Economic Analysis Division, Employment Projections, 2022-2024 and 2021-2030.

Panel A. Short-Term Projections, 2022-2024

Major SOC Group	SOC Code	SOC Detailed Occupational Title	Estimated Employment (2022)	Estimated Employment (2024)	Numerical Change (2022-2024)	Percentage Change (2022-2024)	Annualized Rate of Change
Management	11-9021	Construction Managers	29,575	31,301	1,726	5.8%	2.9%
	11-9179	Personal Services Manager, All Others	##	##	##	##	##
Business and Financial Operations	13-1198	Project Management Specialists and Business Operations Specialists (All Others)	31,426	33,079	1,653	5.3%	2.6%
Computer and Mathematical Operations	15-1253	Software Developers and Software Quality Assurance Analysts and Testers	8,853	9,952	1,099	12.4%	6.2%
Architecture and Engineering	**17-2072**	**Electronic Engineers (except computer)**	**2,122**	**2,204**	**82**	**3.9%**	**1.9%**
Sales and Related	41-3091	Sales Representatives of Services (except advertising, insurance, financial services, and	34,736	36,663	1,927	5.5%	2.8%
Office and Administrative Support	43-4051	Customer Service Representatives	90,672	93,343	2,671	2.9%	1.5%
Construction and Extraction	47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	34,216	35,801	1,585	4.6%	2.3%
	47-2061	Construction Laborers	42,084	44,063	1,979	4.7%	2.4%
	47-2073	Operating Engineers and Other Construction Equipment Operators	14,273	14,765	492	3.4%	1.7%
	47-2111	Electricians	19,533	20,201	668	3.4%	1.7%
Installation, Maintenance, and Repair	49-1011	First-Line Supervisors of Mechanics, Installers and Repairers	19,110	19,835	725	3.8%	1.9%
	49-2021	**Radio, Cellular, and Tower Equipment Installers and Repairers**	**683**	**732**	**49**	**7.2%**	**3.6%**
	49-2022	**Telecommunications Equipment Installers and Repairers (except line installers)**	**5,289**	**5,391**	**102**	**1.9%**	**1.0%**
	49-9051	**Electrical Power-Line Installers and Repairers**	**4,777**	**4,945**	**168**	**3.5%**	**1.8%**
	49-9052	**Telecommunications Line Installers and Repairers**	**3,182**	**3,242**	**60**	**1.9%**	**0.9%**
	49-9098	**Helpers, Installation, Maintenance and Repair Workers**	**3,177**	**3,264**	**87**	**2.7%**	**1.4%**
Production	51-2021	Coil Winders, Tapers, and Finishers	408	402	-6	-1.5%	-0.7%
	51-2028	Electrical, Electronics, & Electromechanical Assemblers (except coli winders, tapers, and finishers)	7,222	7,278	56	0.8%	0.4%
	51-2090	Miscellaneous Assemblers and Fabricators	53,260	43,898	-9,362	-17.6%	-8.8%
		Sector Total	*404,598*	*410,359*	*5,761*	*1.4%*	*0.7%*
		Statewide Total	5,026,613	5,249,706	223,093	4.4%	2.2%

Panel B. Long-Term Projections, 2021-2030							
Major SOC Group	SOC Code	SOC Detailed Occupational Title	Estimated Employment (2021)	Estimated Employment (2030)	Numerical Change (2021-2030)	Percentage Change (2021-2030)	Annualized Rate of Change
Management	11-9021	Construction Managers	28,333	31,454	3,121	11.0%	1.2%
	11-9179	Personal Services Manager, All Others	##	##	##	##	##
Business and Financial Operations	13-1198	Project Management Specialists and Business Operations Specialists (All Others)	30,602	33,739	3,137	10.3%	1.1%
Computer and Mathematical Operations	15-1253	Software Developers and Software Quality Assurance Analysts and Testers	8,401	10,606	2,205	26.2%	2.9%
Architecture and Engineering	**17-2072**	**Electronic Engineers (except computer)**	**2,188**	**2,534**	**346**	**15.8%**	**1.8%**
Sales and Related	41-3091	Sales Representatives of Services (except advertising, insurance, financial services, and	33,391	37,129	3,738	11.2%	1.2%
Office and Administrative Support	43-4051	Customer Service Representatives	88,130	87,703	-427	-0.5%	-0.1%
Construction and Extraction	47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	33,529	36,270	2,741	8.2%	0.9%
	47-2061	Construction Laborers	40,640	44,595	3,955	9.7%	1.1%
	47-2073	Operating Engineers and Other Construction Equipment Operators	14,159	15,682	1,523	10.8%	1.2%
	47-2111	Electricians	19,214	21,935	2,721	14.2%	1.6%
Installation, Maintenance, and Repair	49-1011	First-Line Supervisors of Mechanics, Installers and Repairers	18,809	20,537	1,728	9.2%	1.0%
	49-2021	**Radio, Cellular, and Tower Equipment Installers and Repairers**	**680**	**828**	**148**	**21.8%**	**2.4%**
	49-2022	**Telecommunications Equipment Installers and Repairers (except line installers)**	**5,475**	**6,392**	**917**	**16.7%**	**1.9%**
	49-9051	**Electrical Power-Line Installers and Repairers**	**4,678**	**4,987**	**309**	**6.6%**	**0.7%**
	49-9052	**Telecommunications Line Installers and Repairers**	**3,331**	**3,925**	**594**	**17.8%**	**2.0%**
	49-9098	**Helpers, Installation, Maintenance and Repair Workers**	**3,134**	**3,428**	**294**	**9.4%**	**1.0%**
Production	51-2021	Coil Winders, Tapers, and Finishers	406	356	-50	-12.3%	-1.4%
	51-2028	Electrical, Electronics, & Electromechanical Assemblers (except coli winders, tapers, and finishers)	7,537	8,191	654	8.7%	1.0%
	51-2090	Miscellaneous Assemblers and Fabricators	51,832	50,799	-1,033	-2.0%	-0.2%
		Sector Total	*394,469*	*421,090*	*26,621*	*6.7%*	*0.7%*
		Statewide Total	4,902,016	5,347,745	445,729	9.1%	1.0%
Notes: 1) Detailed occupations in **SHADED BOLD** are highly critical (specialized) to broadband expansion; and 2) A "##" denotes missing, unavailable, or suppressed data.							

A more detailed look at these occupations indicates that many of them rate well in terms of growth and wage prospects. Of the 18 detailed broadband-related occupations for which data are available over the 2021-2030 period, seven are classified as fast-growing jobs that have above median wages under the N.C. Department of Commerce's STAR Jobs classification system.[42] Another five occupations are growing ones that generally pay at least median wages. **Table 15** presents classification data for each of the studied broadband-related occupations.

Table 15. "Star Classification" for Key Occupations in the Broadband Sector, North Carolina, 2021-2030
Source: N.C. Department of Commerce: Labor and Economic Analysis Division, Star Jobs Classification System, 2021-2030, https://tools.nccareers.org/starjobs.

Major SOC Group	SOC Code	SOC Detailed Occupational Title	Overall Star Rating	Star Rating: Annualized Growth	Star Rating: Total Openings	Star Rating: Wages
Management	11-9021	Construction Managers	Best	Very Good	Best	Best
	11-9179	Personal Services Manager, All Others	##	Best	Poor	Very Good
Business and Financial Operations	13-1198	Project Management Specialists and Business Operations Specialists (All Others)	##	Very Good	Best	Very Good
Computer and Mathematical Operations	15-1253	Software Developers and Software Quality Assurance Analysts and Testers	Best	Best	Best	Best
Architecture and Engineering	**17-2072**	**Electronic Engineers (except computer)**	**Best**	**Best**	**Good**	**Best**
Sales and Related	41-3091	Sales Representatives of Services (except advertising, insurance, financial services, and travel)	Best	Very Good	Best	Very Good
Office and Administrative Support	43-4051	Customer Service Representatives	Fair	Poor	Best	Fair
Construction and Extraction	47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	Very Good	Good	Best	Very Good
	47-2061	Construction Laborers	Good	Good	Best	Poor
	47-2073	Operating Engineers and Other Construction Equipment Operators	Very Good	Very Good	Best	Fair
	47-2111	Electricians	Best	Best	Best	Good
Installation, Maintenance, and Repair	49-1011	First-Line Supervisors of Mechanics, Installers and Repairers	Best	Good	Best	Very Good
	49-2021	**Radio, Cellular, and Tower Equipment Installers and Repairers**	**Very Good**	**Best**	**Good**	**Very Good**
	49-2022	**Telecommunications Equipment Installers and Repairers (except line installers)**	**Very Good**	**Best**	**Best**	**Very Good**
	49-9051	**Electrical Power-Line Installers and Repairers**	**Good**	**Fair**	**Very Good**	**Very Good**
	49-9052	**Telecommunications Line Installers and Repairers**	**Very Good**	**Best**	**Very Good**	**Good**
	49-9098	**Helpers, Installation, Maintenance and Repair Workers**	**Good**	**Good**	**Very Good**	**Poor**
Production	51-2021	Coil Winders, Tapers, and Finishers	Poor	Poor	Fair	Good
	51-2028	Electrical, Electronics, & Electromechanical Assemblers (except coli winders, tapers, and finishers)	Good	Fair	Best	Fair
	51-2090	Miscellaneous Assemblers and Fabricators	Fair	Poor	Best	Poor

Note: Detailed occupations in **SHADED BOLD** are highly critical (specialized) to broadband expansion

Remember that not all persons in broadband-related occupations actually will work in the six broadband-related industries featured in this labor analysis, as persons in a given occupation may find employment in multiple industries. To provide a more detailed view of potential growth, **Table 16** applies the national estimates of the industrial-occupational mix discussed in Section 2.4 to the projection data shown in **Table 14**.[43] (This assumes a constant occupational-industrial mix.) In the short term and in the absence of new federal funding (**Panel A**), North Carolina's broadband-related occupations are expected to grow by 5,760 positions between 2022 and 2024, with the critical broadband-related industries accounting for 8% of that growth. In the long term (**Panel B**), North Carolina's broadband-related industries are projected to add 26,620 payroll positions between 2021 and 2030, again with the key broadband-related industries accounting for 8% of the growth. In both scenarios, the larger Telecommunications industry (wired and wireless) is the main source of growth, especially for highly specialized occupations like telecommunications line installers.

The final area to consider is projected job openings, which reflect labor market dynamics. The projections shown in **Table 14** reflect potential increased growth stemming from economic and demographic changes, but the number of actual job openings over the period will be higher due to demand linked to exists, meaning people who leave the labor force altogether (e.g., retire), and transfers, meaning people who switch occupations. To provide more detail, **Table 17** breaks out the sources of demand for each broadband-related occupation considered in this labor analysis for two periods: 2022-2024 and 2021-2030.[44]

Table 16. Projected Changes in Occupational Employment Estimates in Six Key Industries in the Broadband Sector, North Carolina, 2022-2024 and 2021-2030

Sources: N.C. Department of Commerce: Labor and Economic Division, Occupational Employment and Wage Statistics Program, May 2022; N.C. Department of Commerce: Labor and Economic Analysis Division, Employment Projections, 2022-2024 and 2021-2030; and U.S. Bureau of Labor Statistics: Employment Projections Program: National Employment Matrix: Occupations, 2021.

Panel A. Short-Term Projections, 2022-2024

					Power and Communication Line and Related Structure Construction (NAICS: 237130)					Fiber Optic Manufacturing (NAICS: 335920)					All Other Misc. Electrical Equipment and Component Manufacturing (NAICS: 335999)					Cable and Other Subscription Programming (NAICS: 515210)					Wired & Wireless Telecommunications Carriers (NAICS: 517311/12)				
Major SOC Group	SOC Code	SOC Detailed Occupational Title	Estimated Employment (2022)	Estimated Employment (2024)	Share of Occupation (Constant)	Estimated Employment (2022)	Estimated Employment (2024)	Numerical Change (2022-24)	% Change (2022-24)	Share of Occupation (Constant)	Estimated Employment (2022)	Estimated Employment (2024)	Numerical Change (2022-24)	% Change (2022-24)	Share of Occupation (Constant)	Estimated Employment (2022)	Estimated Employment (2024)	Numerical Change (2022-24)	% Change (2022-24)	Share of Occupation (Constant)	Estimated Employment (2022)	Estimated Employment (2024)	Numerical Change (2022-24)	% Change (2022-24)	Share of Occupation (Constant)	Estimated Employment (2022)	Estimated Employment (2024)	Numerical Change (2022-24)	% Change (2022-24)
Management	11-9021	Construction Managers	29,575	31,301	1.5%	444	470	26	0.1%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.3%	89	94	5	0.0%
	11-9179	Personal Services Manager, All Others	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##
Business and Financial Operations	13-1198	Project Management Specialists and Business Operations Specialists (All Others)	31,426	33,079	0.3%	94	99	5	0.0%	0.1%	31	33	2	0.0%	0.1%	31	33	2	0.0%	0.1%	31	33	2	0.0%	1.1%	346	364	18	0.1%
Computer and Mathematical Operations	15-1253	Software Developers and Software Quality Assurance Analysts and Testers	8,853	9,952	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.2%	18	20	2	0.0%	1.6%	142	159	18	0.2%
Architecture and Engineering	**17-2072**	**Electronic Engineers (except computer)**	**2,122**	**2,204**	**0.3%**	**6**	**7**	**0**	**0.0%**	**0.4%**	**8**	**9**	**0**	**0.0%**	**0.4%**	**8**	**9**	**0**	**0.0%**	**0.1%**	**2**	**2**	**0**	**0.0%**	**18.0%**	**382**	**397**	**15**	**0.7%**
Sales and Related	41-3091	Sales Representatives of Services (except advertising, insurance, financial services, and travel)	34,736	36,663	0.4%	139	147	8	0.0%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.3%	104	110	6	0.0%	6.7%	2,327	2,456	129	0.4%
Office and Administrative Support	43-4051	Customer Service Representatives	90,672	93,343	0.0%	0	0	0	0.0%	0.1%	91	93	3	0.0%	0.1%	91	93	3	0.0%	0.1%	91	93	3	0.0%	1.8%	1,632	1,680	48	0.1%
Construction and Extraction	47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	34,216	35,801	2.1%	719	752	33	0.1%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.1%	34	36	2	0.0%
	47-2061	Construction Laborers	42,084	44,063	2.5%	1,052	1,102	49	0.1%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.1%	42	44	2	0.0%
	47-2073	Operating Engineers and Other Construction Equipment Operators	14,273	14,765	3.8%	542	561	19	0.1%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.2%	29	30	1	0.0%
	47-2111	Electricians	19,533	20,201	1.2%	234	242	8	0.0%	0.1%	20	20	1	0.0%	0.1%	20	20	1	0.0%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%
Installation, Maintenance, and Repair	49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	19,110	19,835	2.4%	459	476	17	0.1%	0.1%	19	20	1	0.0%	0.1%	19	20	1	0.0%	0.1%	19	20	1	0.0%	2.8%	535	555	20	0.1%
	49-2021	**Radio, Cellular, and Tower Equipment Installers and Repairers**	**683**	**732**	**11.7%**	**80**	**86**	**6**	**0.8%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**31.6%**	**216**	**231**	**15**	**2.3%**
	49-2022	**Telecommunications Equipment Installers and Repairers (except line installers)**	**5,289**	**5,391**	**0.4%**	**21**	**22**	**0**	**0.0%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**2.0%**	**106**	**108**	**2**	**0.0%**	**65.6%**	**3,470**	**3,536**	**67**	**1.3%**
	49-9051	**Electrical Power-Line Installers and Repairers**	**4,777**	**4,945**	**30.8%**	**1,471**	**1,523**	**52**	**1.1%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**0.2%**	**10**	**10**	**0**	**0.0%**
	49-9052	**Telecommunications Line Installers and Repairers**	**3,182**	**3,242**	**14.7%**	**468**	**477**	**9**	**0.3%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**1.2%**	**38**	**39**	**1**	**0.0%**	**59.6%**	**1,896**	**1,932**	**36**	**1.1%**
	49-9098	**Helpers, Installation, Maintenance and Repair Workers**	**3,177**	**3,264**	**1.3%**	**41**	**42**	**1**	**0.0%**	**0.6%**	**19**	**20**	**1**	**0.0%**	**0.6%**	**19**	**20**	**1**	**0.0%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**0.3%**	**10**	**10**	**0**	**0.0%**
Production	51-2021	Coil Winders, Tapers, and Finishers	408	402	0.0%	0	0	0	0.0%	4.5%	18	18	0	-0.1%	4.5%	18	18	0	-0.1%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%
	51-2028	Electrical, Electronics, & Electromechanical Assemblers (except coil winders, tapers, and finishers)	7,222	7,278	0.0%	0	0	0	0.0%	10.1%	729	735	6	0.1%	10.1%	729	735	6	0.1%	0.0%	0	0	0	0.0%	0.1%	7	7	0	0.0%
	51-2090	Miscellaneous Assemblers and Fabricators	53,260	43,898	0.0%	0	0	0	0.0%	1.1%	586	483	-103	-0.2%	1.1%	586	483	-103	-0.2%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%
			Industry Totals		*##*	*5,771*	*6,004*	*234*	*4.0%*	*##*	*1,522*	*1,431*	*-91*	*-6.0%*	*##*	*1,522*	*1,431*	*-91*	*-6.0%*	*##*	*409*	*425*	*16*	*3.9%*	*##*	*11,166*	*11,542*	*377*	*3.4%*

Table 16. Projected Changes in Occupational Employment Estimates in Six Key Industries in the Broadband Sector, North Carolina, 2022-2024 and 2021-2030

Panel B. Long-Term Projections, 2021-2030

					Power and Communication Line and Related Structure Construction (NAICS: 237130)					Fiber Optic Manufacturing (NAICS: 335920)					All Other Misc. Electrical Equipment and Component Manufacturing (NAICS: 335999)					Cable and Other Subscription Programming (NAICS: 515210)					Wired & Wireless Telecommunications Carriers (NAICS: 517311/12)				
Major SOC Group	SOC Code	SOC Detailed Occupational Title	Estimated Employment (2021)	Estimated Employment (2030)	Share of Occupation (Constant)	Estimated Employment (2021)	Estimated Employment (2030)	Numerical Change (2021-30)	% Change (2021-30)	Share of Occupation (Constant)	Estimated Employment (2021)	Estimated Employment (2030)	Numerical Change (2021-30)	% Change (2021-30)	Share of Occupation (Constant)	Estimated Employment (2021)	Estimated Employment (2030)	Numerical Change (2021-30)	% Change (2021-30)	Share of Occupation (Constant)	Estimated Employment (2021)	Estimated Employment (2030)	Numerical Change (2021-30)	% Change (2021-30)	Share of Occupation (Constant)	Estimated Employment (2021)	Estimated Employment (2030)	Numerical Change (2021-30)	% Change (2021-30)
Management	11-9021	Construction Managers	28,333	31,454	1.5%	425	472	47	0.2%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.3%	85	94	9	0.0%
	11-9179	Personal Services Manager, All Others	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##	##
Business and Financial Operations	13-1198	Project Management Specialists and Business Operations Specialists (All Others)	30,602	33,739	0.3%	92	101	9	0.0%	0.1%	31	34	3	0.0%	0.1%	31	34	3	0.0%	0.1%	31	34	3	0.0%	1.1%	337	371	35	0.1%
Computer and Mathematical Operations	15-1253	Software Developers and Software Quality Assurance Analysts and Testers	8,401	10,606	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.2%	17	21	4	0.1%	1.6%	134	170	35	0.4%
Architecture and Engineering	**17-2072**	**Electronic Engineers (except computer)**	**2,188**	**2,534**	**0.3%**	**7**	**8**	**1**	**0.0%**	**0.4%**	**9**	**10**	**1**	**0.1%**	**0.4%**	**9**	**10**	**1**	**0.1%**	**0.1%**	**2**	**3**	**0**	**0.0%**	**18.0%**	**394**	**456**	**62**	**2.8%**
Sales and Related	41-3091	Sales Representatives of Services (except advertising, insurance, financial services, and travel)	33,391	37,129	0.4%	134	149	15	0.0%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.3%	100	111	11	0.0%	6.7%	2,237	2,488	250	0.8%
Office and Administrative Support	43-4051	Customer Service Representatives	88,130	87,703	0.0%	0	0	0	0.0%	0.1%	88	88	0	0.0%	0.1%	88	88	0	0.0%	0.1%	88	88	0	0.0%	1.8%	1,586	1,579	-8	0.0%
Construction and Extraction	47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	33,529	36,270	2.1%	704	762	58	0.2%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.1%	34	36	3	0.0%
	47-2061	Construction Laborers	40,640	44,595	2.5%	1,016	1,115	99	0.2%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.1%	41	45	4	0.0%
	47-2073	Operating Engineers and Other Construction Equipment Operators	14,159	15,682	3.8%	538	596	58	0.4%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%	0.2%	28	31	3	0.0%
	47-2111	Electricians	19,214	21,935	1.2%	231	263	33	0.2%	0.1%	19	22	3	0.0%	0.1%	19	22	3	0.0%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%
Installation, Maintenance, and Repair	49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	18,809	20,537	2.4%	451	493	41	0.2%	0.1%	19	21	2	0.0%	0.1%	19	21	2	0.0%	0.1%	19	21	2	0.0%	2.8%	527	575	48	0.3%
	49-2021	**Radio, Cellular, and Tower Equipment Installers and Repairers**	**680**	**828**	**11.7%**	**80**	**97**	**17**	**2.5%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**31.6%**	**215**	**262**	**47**	**6.9%**
	49-2022	**Telecommunications Equipment Installers and Repairers (except line installers)**	**5,475**	**6,392**	**0.4%**	**22**	**26**	**4**	**0.1%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**2.0%**	**110**	**128**	**18**	**0.3%**	**65.6%**	**3,592**	**4,193**	**602**	**11.0%**
	49-9051	**Electrical Power-Line Installers and Repairers**	**4,678**	**4,987**	**30.8%**	**1,441**	**1,536**	**95**	**2.0%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**0.2%**	**9**	**10**	**1**	**0.0%**
	49-9052	**Telecommunications Line Installers and Repairers**	**3,331**	**3,925**	**14.7%**	**490**	**577**	**87**	**2.6%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**1.2%**	**40**	**47**	**7**	**0.2%**	**59.6%**	**1,985**	**2,339**	**354**	**10.6%**
	49-9098	**Helpers, Installation, Maintenance and Repair Workers**	**3,134**	**3,428**	**1.3%**	**41**	**45**	**4**	**0.1%**	**0.6%**	**19**	**21**	**2**	**0.1%**	**0.6%**	**19**	**21**	**2**	**0.1%**	**0.0%**	**0**	**0**	**0**	**0.0%**	**0.3%**	**9**	**10**	**1**	**0.0%**
Production	51-2021	Coil Winders, Tapers, and Finishers	406	356	0.0%	0	0	0	0.0%	4.5%	18	16	-2	-0.6%	4.5%	18	16	-2	-0.6%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%
	51-2028	Electrical, Electronics, & Electromechanical Assemblers (except coli winders, tapers, and finishers)	7,537	8,191	0.0%	0	0	0	0.0%	10.1%	761	827	66	0.9%	10.1%	761	827	66	0.9%	0.0%	0	0	0	0.0%	0.1%	8	8	1	0.0%
	51-2090	Miscellaneous Assemblers and Fabricators	51,832	50,799	0.0%	0	0	0	0.0%	1.1%	570	559	-11	0.0%	1.1%	570	559	-11	0.0%	0.0%	0	0	0	0.0%	0.0%	0	0	0	0.0%
			Industry Totals		*##*	*5,670*	*6,238*	*568*	*10.0%*	*##*	*1,534*	*1,597*	*63*	*4.1%*	*##*	*1,534*	*1,597*	*63*	*4.1%*	*##*	*406*	*452*	*46*	*11.3%*	*##*	*11,221*	*12,667*	*1,447*	*12.9%*

Notes: 1) Detailed occupations in **SHADED BOLD** are highly critical (specialized) to broadband expansion; 2) " ##" denotes a category with missing, unavailable, or suppressed data; 3) the employment values are estimates subject to error; and 4) as disaggregated data are not available for NAICS codes 57311/12, the categories are combined.

Table 17. Projected Changes in Job Openings in Key Occupations in the Broadband Sector by Source of Change, North Carolina, 2022-2024 and 2021-2030

Source: N.C. Department of Commerce: Labor and Economic Analysis Division, Employment Projections, 2022-2024 and 2021-2030.

Panel A. Short-Term Projections, 2022-2024

Major SOC Group	SOC Code	SOC Detailed Occupational Title	Total Openings	Openings Due to Change	Openings Due to Transfers	Openings Due to Exits	Share of Openings Due to Change	Share of Openings Due to Transfers	Share of Openings Due to Exits	Total Openings Per Year	Total Openings Due to Change Per Year	Total Openings Due to Transfers Per Year	Total Openings Due to Exists Per Year
Management	11-9021	Construction Managers	6,368	1,726	3,222	1,420	27.1%	50.6%	22.3%	3,184	863	1,611	710
	11-9179	Personal Services Manager, All Others	##	##	##	##	##	##	##	##	##	##	##
Business and Financial Operations	13-1198	Project Management Specialists and Business Operations Specialists (All Others)	7,676	1,653	3,938	2,085	21.5%	51.3%	27.2%	3,838	827	1,969	1,043
Computer and Mathematical Operations	15-1253	Software Developers and Software Quality Assurance Analysts and Testers	2,439	1,099	900	440	45.1%	36.9%	18.0%	1,220	550	450	220
Architecture and Engineering	**17-2072**	**Electronic Engineers (except computer)**	**350**	**82**	**158**	**110**	**23.4%**	**45.1%**	**31.4%**	**175**	**41**	**79**	**55**
Sales and Related	41-3091	Sales Representatives of Services (except advertising, insurance, financial services, and travel)	9,600	1,927	5,653	2,020	20.1%	58.9%	21.0%	4,800	964	2,827	1,010
Office and Administrative Support	43-4051	Customer Service Representatives	28,529	2,671	15,715	10,143	9.4%	55.1%	35.6%	14,265	1,336	7,858	5,072
Construction and Extraction	47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	8,088	1,585	4,221	2,282	19.6%	52.2%	28.2%	4,044	793	2,111	1,141
	47-2061	Construction Laborers	10,381	1,979	5,343	3,059	19.1%	51.5%	29.5%	5,191	990	2,672	1,530
	47-2073	Operating Engineers and Other Construction Equipment Operators	3,445	492	1,919	1,034	14.3%	55.7%	30.0%	1,723	246	960	517
	47-2111	Electricians	4,711	668	2,686	1,357	14.2%	57.0%	28.8%	2,356	334	1,343	679
Installation, Maintenance, and Repair	49-1011	First-Line Supervisors of Mechanics, Installers and Repairers	4,344	725	2,161	1,458	16.7%	49.7%	33.6%	2,172	363	1,081	729
	49-2021	**Radio, Cellular, and Tower Equipment Installers and Repairers**	**209**	**49**	**106**	**54**	**23.4%**	**50.7%**	**25.8%**	**105**	**25**	**53**	**27**
	49-2022	**Telecommunications Equipment Installers and Repairers (except line installers)**	**1,315**	**102**	**804**	**409**	**7.8%**	**61.1%**	**31.1%**	**658**	**51**	**402**	**205**
	49-9051	**Electrical Power-Line Installers and Repairers**	**974**	**168**	**583**	**223**	**17.2%**	**59.9%**	**22.9%**	**487**	**84**	**292**	**112**
	49-9052	**Telecommunications Line Installers and Repairers**	**739**	**60**	**487**	**192**	**8.1%**	**65.9%**	**26.0%**	**370**	**30**	**244**	**96**
	49-9098	**Helpers, Installation, Maintenance and Repair Workers**	**862**	**87**	**418**	**357**	**10.1%**	**48.5%**	**41.4%**	**431**	**44**	**209**	**179**
Production	51-2021	Coil Winders, Tapers, and Finishers	86	-6	53	39	-7.0%	61.6%	45.3%	43	-3	27	20
	51-2028	Electrical, Electronics, & Electromechanical Assemblers (except coli winders, tapers, and finishers)	1,711	56	956	699	3.3%	55.9%	40.9%	856	28	478	350
	51-2090	Miscellaneous Assemblers and Fabricators	13,018	638	7,694	4,686	4.9%	59.1%	36.0%	6,509	319	3,847	2,343
		Sector Total	*104,845*	*15,761*	*57,017*	*32,067*	*15.0%*	*54.4%*	*30.6%*	*52,423*	*7,881*	*28,509*	*16,034*
		Statewide Total	1,407,687	223,093	691,565	493,029	15.8%	49.1%	35.0%	703,844	111,547	345,783	246,515

Notes: 1) Detailed occupations in SHADED BOLD are highly critical (specialized) to broadband expansion; 2) A "##" denotes missing, unavailable, or suppressed data; 3) "Change" reflects openings resulting from economic and demographic change; 4) "Transfers" reflect openings resulting from switches in occupation; 5) "Exits" reflect openings resulting from persons leaving the labor force entirely; and 6) not all categories may sum due to rounding.

Table 17. Projected Changes in Job Openings in Key Occupations in the Broadband Sector by Source of Change, North Carolina, 2022-2024 and 2021-2030

Source: N.C. Department of Commerce: Labor and Economic Analysis Division, Employment Projections, 2022-2024 and 2021-2030.

Panel B. Long-Term Projections, 2021-2030

Major SOC Group	SOC Code	SOC Detailed Occupational Title	Total Openings	Openings Due to Change	Openings Due to Transfers	Openings Due to Exits	Share of Openings Due to Change	Share of Openings Due to Transfers	Share of Openings Due to Exits	Total Openings Per Year	Total Openings Due to Change Per Year	Total Openings Due to Transfers Per Year	Total Openings Due to Exists Per Year
Management	11-9021	Construction Managers	25,915	3,121	15,820	6,974	12.0%	61.0%	26.9%	2,879	347	1,758	775
	11-9179	Personal Services Manager, All Others	##	##	##	##	##	##	##	##	##	##	##
Business and Financial Operations	13-1198	Project Management Specialists and Business Operations Specialists (All Others)	33,178	3,137	19,640	10,401	9.5%	59.2%	31.3%	3,686	349	2,182	1,156
Computer and Mathematical Operations	15-1253	Software Developers and Software Quality Assurance Analysts and Testers	8,978	2,205	4,547	2,226	24.6%	50.6%	24.8%	998	245	505	247
Architecture and Engineering	**17-2072**	**Electronic Engineers (except computer)**	**1,806**	**346**	**862**	**598**	**19.2%**	**47.7%**	**33.1%**	**201**	**38**	**96**	**66**
Sales and Related	41-3091	Sales Representatives of Services (except advertising, insurance, financial services, and travel)	41,632	3,738	27,919	9,975	9.0%	67.1%	24.0%	4,626	415	3,102	1,108
Office and Administrative Support	43-4051	Customer Service Representatives	123,114	-427	75,080	48,460	-0.3%	61.0%	39.4%	13,679	-47	8,342	5,384
Construction and Extraction	47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	35,156	2,741	10,041	11,374	7.8%	28.6%	32.4%	3,906	305	1,116	1,264
	47-2061	Construction Laborers	45,519	3,955	26,431	15,133	8.7%	58.1%	33.2%	5,058	439	2,937	1,681
	47-2073	Operating Engineers and Other Construction Equipment Operators	16,697	1,523	9,859	5,315	9.1%	59.0%	31.8%	1,855	169	1,095	591
	47-2111	Electricians	22,653	2,721	13,906	7,026	12.0%	61.4%	31.0%	2,517	302	1,545	781
Installation, Maintenance, and Repair	49-1011	First-Line Supervisors of Mechanics, Installers and Repairers	20,009	1,728	10,917	7,364	8.6%	54.6%	36.8%	2,223	192	1,213	818
	49-2021	**Radio, Cellular, and Tower Equipment Installers and Repairers**	**1,004**	**148**	**567**	**289**	**14.7%**	**56.5%**	**28.8%**	**112**	**16**	**63**	**32**
	49-2022	**Telecommunications Equipment Installers and Repairers (except line installers)**	**7,657**	**917**	**4,466**	**2,274**	**12.0%**	**58.3%**	**29.7%**	**851**	**102**	**496**	**253**
	49-9051	**Electrical Power-Line Installers and Repairers**	**4,316**	**309**	**2,898**	**1,109**	**7.2%**	**67.1%**	**25.7%**	**480**	**34**	**322**	**123**
	49-9052	**Telecommunications Line Installers and Repairers**	**4,430**	**594**	**2,752**	**1,084**	**13.4%**	**62.1%**	**24.5%**	**492**	**66**	**306**	**120**
	49-9098	**Helpers, Installation, Maintenance and Repair Workers**	**4,240**	**294**	**2,128**	**1,818**	**6.9%**	**50.2%**	**42.9%**	**471**	**33**	**236**	**202**
Production	51-2021	Coil Winders, Tapers, and Finishers	385	-50	251	184	-13.0%	65.2%	47.8%	43	-6	28	20
	51-2028	Electrical, Electronics, & Electromechanical Assemblers (except coli winders, tapers, and finishers)	9,630	654	5,185	3,791	6.8%	53.8%	39.4%	1,070	73	576	421
	51-2090	Miscellaneous Assemblers and Fabricators	58,252	-1,033	36,845	22,440	-1.8%	63.3%	38.5%	6,472	-115	4,094	2,493
		Sector Total	*464,571*	*26,621*	*270,114*	*157,835*	*5.7%*	*58.1%*	*34.0%*	*51,619*	2,958	30,013	17,537
		Statewide Total	6,350,702	445,729	3,448,135	2,456,838	15.8%	49.1%	38.7%	705,634	49,525	383,126	272,982

Notes: 1) Detailed occupations in SHADED BOLD are highly critical (specialized) to broadband expansion; 2) A "##" denotes missing, unavailable, or suppressed data; 3) "Change" reflects openings resulting from economic and demographic change; 4) "Transfers" reflect openings resulting from switches in occupation; 5) "Exits" reflect openings resulting from persons leaving the labor force entirely; and 6) not all categories may sum due to rounding.

In the short term, absent any external changes like BEAD Program funding (**Panel A**), North Carolina's broadband-related occupations are projected to have 104,850 job openings between 2022 and 2024, although not all the openings will be in actual broadband industries.[45] More than half of the projected demand is attributable to persons transferring out of a given occupation, and 31% is due to people leaving the labor force entirely. The six most highly specialized discussed throughout this labor analysis (marked in shaded bold) are especially prone to short-term change: two-thirds of the projected openings for telecommunications line installers and repairers are linked to occupational transfers, while 41% of helpers-line installation, maintenance, and repair workers are expected to leave the labor force entirely.

Turing to the long term, (**Panel B** in **Table 17**), North Carolina's broadband-related occupations are projected to have 464,570 job openings between 2021 and 2030. [46] That translates into 51,620 openings per year, although not all of the openings will be in broadband industries. Nealy 60% of the projected openings are attributable to persons transferring out of a given occupation, with 34% due to people leaving the labor force entirely. The six most highly specialized occupations discussed throughout this labor analysis (marked in shaded bold) are especially prone to changes stemming from occupational transfers and labor force exists. In both the short-term and long-term scenarios, the sizable share of openings linked to occupational transfers raises questions about the factors like job quality that contribute to job churning, the firm-level and industrial practices that promote churn, and the ability of firms to retain the necessary workforce to handle increased demand for their goods and services.

5.1 Incremental Changes in Demand Linked to Federal Investments

Modeling the incremental economic changes from an external increase in demand for the goods and services produced by a given industry is another speculative exercise. In theory, every $1 in increased demand from outside a local economy will generate more than $1 in impact.[47] Imagine if an existing factory in North Carolina obtained new sales from outside the state. The direct impact would be the value of the additional goods produced by the factory, while the indirect impact would reflect the purchase of additional supplies from other local businesses. Over time, these impacts will pass through to local households via higher incomes, leading to induced impacts in the form of increased spending. The total economic impact would be the sum of all three effects. While this sounds reasonable, the modeling hinges on such implausible assumptions as the existence of full employment, uniform production processes, instantaneous response, fixed industrial structures, and constant wages and prices.[48] Yet projections can aid public planning processes, so this section of the labor analysis uses published research to estimate increased labor demand tied to BEAD Program funding and related federal funds.

Research suggests that every $1 million in federal funds invested in high-speed internet expansion access generates 2.5 direct jobs, which are jobs in the directly affected industries.[49] (The funds also yield indirect and induced jobs, but this analysis focuses solely on direct jobs.) In June 2023, the U.S. Department of Commerce announced that North Carolina would receive a BEAD grant totaling $1.5 billion.[50] Additionally, the division plans to direct an additional $0.9 billion in federal American Rescue Plan (ARP) funds to high-speed internet expansion.[51] The result is a potential external federal investment of $2.5 billion in broadband expansion.

Table 18 presents the distribution of these jobs across the six broadband-related industries discussed in this labor analysis, weighted by each industry's relative contribution to the larger sector.[52] Based on those weights, a $1 million external investment will yield 0.63 direct jobs in the Power and Communications Line and Related Structures Construction industry, 0.5 direct jobs each among Wired and Wireless Telecommunications Carriers, 0.38 direct jobs in the All Other Miscellaneous Electrical Equipment and Component Manufacturing industry, and 0.25

direct jobs in each of the Fiber Optic Cable Manufacturing and Cable and Other Subscription Programing industries. Given that, a BEAD Program award of $1.5 billion will yield an estimated 3,832 direct jobs in North Carolina's broadband industry. When direct jobs tied to federal ARP funds are added, the potential employment impact rises to 6,174 direct jobs.

Table 18. Changes in Estimated Number of Direct Jobs Resulting from Federal BEAD and ARP Funding in Key Industries in the Broadband Sector, Ranked by Size, North Carolina, 2023

Sources: Author's analysis based on data provided by N.C. Department of Information Technology; and Marcela Escobari, Dhruv Gandhi, and Sebastian Strauss, How Federal Infrastructure Investment Can Put America to Work (Washington, DC: Brookings Institution, 2021).

				Federal BEAD Funds	Federal ARP Funds	Combined Federal BEAD and ARP Funds
Six-Digit NAICS Code	NAICS Industry Title (2017)	Industry Weight	Direct Jobs Per $1 million	Estimated Direct Jobs at $1.5 Billion	Estimated Direct Jobs at $0.9 Billion	Estimated Direct Jobs at $2.5 Billion
237130	Power and Communication Line and Related Structures Construction	25.0%	0.63	958	585	1,543
517311	Wired Telecommunications Carriers	20.0%	0.50	766	468	1,235
517312	Wireless Telecommunications Carriers	20.0%	0.50	766	468	1,235
335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing	15.0%	0.38	575	351	926
335921	Fiber Optic Cable Manufacturing	10.0%	0.25	383	234	617
515210	Cable and Other Subscription Programming	10.0%	0.25	383	234	617
	Sector Total	100.0%	2.5	3,832	2,341	6,174

As noted previously, each industry relies on a specific occupational mix to produce its goods and services. Drawing on the industrial weights just discussed, **Table 19** estimates the potential occupational distribution of the direct jobs linked to external federal investment in North Carolina's high-speed internet infrastructure. [53] Data are shown for the broadest occupational groupings (2-digit Standard Occupational Classification System code). Some 90% of the potential new jobs involve only seven of the 23 major SOC groups, with nearly one-third of the jobs involving an installation, maintenance, or repair occupation. By extension, a BEAD Program grant of $1.5 billion will yield an estimated 3,431 direct jobs across these seven major categories. When direct jobs related to federal ARP funds are included, the potential employment impact rises to 5,527 direct jobs.

Table 19. Changes in Estimated Number of Direct Jobs Resulting from Federal BEAD and ARP Funding in Key Occupations in the Broadband Sector, Ranked by Size, North Carolina, 2023

Sources: Author's analysis based on data provided by N.C. Department of Information Technology; and Marcela Escobari, Dhruv Gandhi, and Sebastian Strauss, How Federal Infrastructure Investment Can Put America to Work (Washington, DC: Brookings Institution, 2021).

				Federal BEAD Funds	Federal ARP Funds	Combined Federal BEAD and ARP Funds
SOC Code (2-Digit)	SOC Title	Estimated Share of Jobs	Direct Jobs Per $1 million	Estimated Direct Jobs at $1.5 Billion	Estimated Direct Jobs at $0.9 Billion	Estimated Direct Jobs at $2.5 Billion
49	Installation, Maintenance, and Repair	31.5%	0.8	1,205	736	1,941
43	Office and Administrative Support	13.5%	0.3	518	316	834
15	Computer and Mathematical	11.6%	0.3	445	272	716
47	Construction and Extraction	11.1%	0.3	427	261	687
41	Sales and Related	10.1%	0.3	387	237	624
13	Business and Financial Operations	6.4%	0.2	243	149	392
11	Management	5.4%	0.1	206	126	332
	Subtotal	89.5%	2.2	3,431	2,096	5,527
	All Other Major SOC Groups (Remaining 15)	*10.5%*	*0.3*	*401*	*245*	*646*
	Total	**100.0%**	**2.5**	**3,832**	**2,341**	**6,173**

Other national research suggests that the occupational impacts are even more concentrated, with 55% of all direct job creation involving just 12 of the 867 detailed occupations in the SOC framework.[54] As shown in **Table 20**, a BEAD Program grant of $1.5 billion will yield an estimated 2,121 direct jobs across the 12 most-affected detailed occupations. When direct jobs related to federal ARP funds are added, the potential employment impact rises to 3,417 direct jobs.

Table 20. Changes in Estimated Number of Direct Jobs Resulting from Federal BEAD and ARP Funding in 12 Key Occupations in the Broadband Sector Most Impacted by Federal Investment, Ranked by Size, North Carolina, 2023
Sources: Author's analysis based on data provided by N.C. Department of Information Technology; and Marcela Escobari, Dhruv Gandhi, and Sebastian Strauss, How Federal Infrastructure Investment Can Put America to Work (Washington, DC: Brookings Institution, 2021).

				Federal BEAD Funds	Federal ARP Funds	Combined Federal BEAD and ARP Funds
SOC Code (6-Digit)	SOC Title	Estimated Share of Jobs	Direct Jobs Per $1 million	Estimated Direct Jobs at $1.5 Billion	Estimated Direct Jobs at $0.9 Billion	Estimated Direct Jobs at $2.5 Billion
49-2022	**Telecommunications Equipment Installers and Repairers (except line installers)**	**13.8%**	**0.3**	**529**	**323**	**852**
49-9052	**Telecommunications Line Installers and Repairers**	**9.2%**	**0.2**	**353**	**216**	**569**
41-3091	Sales Representatives of Services (except advertising, insurance, financial services, and travel)	6.4%	0.2	244	149	394
43-4051	Customer Service Representatives	6.3%	0.2	241	147	388
47-2061	Construction Laborers	4.7%	0.1	180	110	291
49-9051	**Electrical Power-Line Installers and Repairers**	**4.1%**	**0.1**	**159**	**97**	**256**
15-1253	Software Developers and Software Quality Assurance Analysts and Testers	2.7%	0.1	102	62	164
13-1198	Project Management Specialists and Business Operations Specialists (All Others)	2.4%	0.1	94	57	151
49-1011	First-Line Supervisors of Mechanics, Installers and Repairers	2.4%	0.1	94	57	151
17-2072	**Electronic Engineers (except computer)**	**2.2%**	**0.1**	**84**	**51**	**135**
49-2021	**Radio, Cellular, and Tower Equipment Installers and Repairers**	**0.8%**	**0.0**	**31**	**19**	**50**
49-9098	**Helpers, Installation, Maintenance and Repair Workers**	**0.3%**	**0.0**	**11**	**7**	**18**
	Subtotal	55.4%	1.4	2,121	1,296	3,417
	All Other SOC Detailed Occupations (Remaining 855)	*44.7%*	*1.1*	*1,711*	*1,045*	*2,756*
	Total	**100.0%**	**2.5**	**3,832**	**2,341**	**6,173**

Note: Detailed occupations in **SHADED BOLD** are highly critical (specialized) to broadband expansion.

The detailed occupations listed on **Table 20** include all six of the most highly specialized broadband-related occupations discussed in this labor analysis (marked in shaded bold).[55] Those occupations collectively account for 30% of all projected direct job creation, with telecommunications equipment installers and repairers (except line installers) and telecommunications line installers and repairers responsible for almost a quarter of the total.

While the direct job creation numbers shared so far in this section are assumed to occur all at once as the result of a lump sum investment, the BEAD Program will unfold over a period of time. **Table 21** therefore converts the detailed occupational projections shared in **Table 20** into annualized estimates over a five-year window. Viewed through that lens, a BEAD Program grant of $1.5 billion will yield an estimated 766 direct jobs per year in North Carolina's broadband industry. When direct jobs related to federal ARP funds are included, the potential employment impact rises to 1,235 direct jobs per year.

Table 21. Annualized Change over Five Years in Estimated Number of Direct Jobs Resulting from Federal BEAD and ARP Funding in 12 Key Occupations in the Broadband Sector Most Impacted by Federal Investment Ranked by Size, North Carolina, 2024-202800010

Sources: Author's analysis based on data provided by N.C. Department of Information Technology; and Marcela Escobari, Dhruv Gandhi, and Sebastian Strauss, How Federal Infrastructure Investment Can Put America to Work (Washington, DC: Brookings Institution, 2021).

				Federal BEAD Funds Per Year	Federal ARP Funds Per Year	Combined Federal BEAD and ARP Funds Per Year
SOC Code (6-Digit)	SOC Title	Estimated Share of Jobs	Direct Jobs Per $1 million	Estimated Direct Jobs at $1.5 Billion	Estimated Direct Jobs at $0.9 Billion	Estimated Direct Jobs at $2.5 Billion
49-2022	**Telecommunications Equipment Installers and Repairers (except line installers)**	**13.8%**	**0.3**	**106**	**65**	**170**
49-9052	**Telecommunications Line Installers and Repairers**	**9.2%**	**0.2**	**71**	**43**	**114**
41-3091	Sales Representatives of Services (except advertising, insurance, financial services, and travel)	6.4%	0.2	49	**30**	79
43-4051	Customer Service Representatives	6.3%	0.2	48	**29**	78
47-2061	Construction Laborers	4.7%	0.1	36	**22**	58
49-9051	**Electrical Power-Line Installers and Repairers**	**4.1%**	**0.1**	**32**	**19**	**51**
15-1253	Software Developers and Software Quality Assurance Analysts and Testers	2.7%	0.1	20	**12**	33
13-1198	Project Management Specialists and Business Operations Specialists (All Others)	2.4%	0.1	19	**11**	30
49-1011	First-Line Supervisors of Mechanics, Installers and Repairers	2.4%	0.1	19	**11**	30
17-2072	**Electronic Engineers (except computer)**	**2.2%**	**0.1**	**17**	**10**	**27**
49-2021	**Radio, Cellular, and Tower Equipment Installers and Repairers**	**0.8%**	**0.0**	**6**	**4**	**10**
49-9098	**Helpers, Installation, Maintenance and Repair Workers**	**0.3%**	**0.0**	**2**	**1**	**4**
	Subtotal	55.4%	1.4	424	259	683
	All Other SOC Detailed Occupations (Remaining 855)	*44.7%*	*1.1*	*342*	*209*	*551*
	Total	**100.0%**	**2.5**	**766**	**468**	**1,235**

Note: Detailed occupations in **SHADED BOLD** are highly critical (specialized) to broadband expansion.

Remember that the direct job creation figures linked to federal funding reflect new demand above the baseline figures explored in Section 5.1. Put differently, federal funds will create a demand for jobs each year above and beyond the baseline conditions. **Table 22** combines the baseline annual job openings projected to occur each year in North Carolina between 2021 and 2030 first shown in **Table 17** with the estimated incremental annual demand detailed in **Table 21**. For the 12 key broadband-related occupations listed, the combination of federal BEAD Program and ARP funding will increase the number of job openings by an estimated 682 openings per year (+2%). The largest impacts appear in the most highly specialized broadband-related occupations, primarily installation, repair, and maintenance ones.

Table 22. Annualized Change over Five Years in Estimated Number of Direct Jobs Resulting from Federal BEAD and ARP Funding in 12 Key Occupations in the Broadband Sector Most Impacted by Federal Investment, Ranked by Share of Baseline Job Openings, 2024-2028

Sources: Author's analysis based on data from N.C. Department of Commerce: Labor and Economic Analysis Division, Employment Projections, 2021-2030; and Marcela Escobari, Dhruv Gandhi, and Sebastian Strauss, How Federal Infrastructure Investment Can Put America to Work (Washington, DC: Brookings Institution, 2021).

SOC Code (6-Digit)	SOC Title	Total Openings (Baseline)	Federal BEAD Funds Per Year Estimated Direct Jobs at $1.5 Billion	Federal ARP Funds Per Year Estimated Direct Jobs at $0.9 Billion	Combined Federal BEAD and ARP Funds Per Estimated Direct Jobs at $2.5 Billion	Combined BEAD and ARP Funds Estimated Direct Jobs Per Year as Share of Baseline Openings
49-9052	**Telecommunications Line Installers and Repairers**	**480**	**71**	**43**	**114**	**23.8%**
49-2022	**Telecommunications Equipment Installers and Repairers (except line installers)**	**851**	**106**	**65**	**171**	**20.1%**
17-2072	**Electronic Engineers (except computer)**	**201**	**17**	**10**	**27**	**13.4%**
49-9051	**Electrical Power-Line Installers and Repairers**	**480**	**32**	**19**	**51**	**10.6%**
49-2021	**Radio, Cellular, and Tower Equipment Installers and Repairers**	**112**	**6**	**4**	**10**	**8.9%**
15-1253	Software Developers and Software Quality Assurance Analysts and Testers	998	**20**	**12**	**32**	3.2%
41-3091	Sales Representatives of Services (except advertising, insurance, financial services, and travel)	4,626	49	**30**	79	1.7%
47-2061	Construction Laborers	5,058	36	**22**	58	1.1%
13-1198	Project Management Specialists and Business Operations Specialists (All Others)	3,686	19	**11**	30	0.8%
49-1011	First-Line Supervisors of Mechanics, Installers and Repairers	3,906	**19**	**11**	**30**	0.8%
49-9098	**Helpers, Installation, Maintenance and Repair Workers**	**492**	**2**	**1**	**3**	**0.6%**
43-4051	Customer Service Representatives	13,679	**48**	**29**	**77**	0.6%
	Subtotal for Selected Occupations	34,569	425	257	682	2.0%
Note: Detailed occupations in SHADED BOLD are highly critical (specialized) to broadband expansion.						

In the grand scheme of North Carolina's labor market, the number of direct jobs potentially attributable to a BEAD Program grant of $1.5 billion is modest; even if all the jobs were created at once, the estimated total would be 3,832 direct jobs, and if federal ARP funds are included, the potential impact rises to 6,173 direct jobs. For perspective, there was an average of 226,000 unemployed North Carolinians in 2021, along with another 82,000 persons who worked part time despite wanting full-time work.[56] Among these unemployed and underemployed individuals are many in relevant occupational categories. In 2021, there were an estimated 2,000 experienced workers in installation, maintenance, occupations who were jobless and actively seeking work, along with 14,000 similarly situated construction workers. And each year young adults age into the workforce while older individuals re-enter after having pursued additional education or providing familiar care.

Of course, not all of these individuals may have skills and training needed to enter the broadband-related sector immediately, but the point is that the potential workers already exist to respond to increased demand in the sector resulting from federal investments. Employers may need to adjust their understanding of the skills required to be a successful worker and abandon any preconceptions about the demographic characteristics associated with a successful worker in a given field. Employers also can partner with North Carolina's two-year colleges and public workforce system to help access and train new pools of potential workers—workers who may benefit greatly from expanded job opportunities in a growing sector.

6. Conclusion

Federal funds provided to North Carolina as part of the BEAD Program will underwrite the expansion of high-speed internet service into communities long separated from the economic, educational, and cultural opportunities available through the internet. Yet no amount of money will connect isolated communities to the internet absent the existence of an appropriately sized, qualified, and compensated broadband workforce. This labor analysis therefore provides an initial overview of the state's current and potential broadband workforce so as to establish a common baseline for planning with such BEAD Program stakeholders as industry partners, educational providers, and organized labor. By sharing the research with key informants and

incorporating their knowledge, this iterative planning process can foster the growth of a diverse broadband workforce that enjoys good jobs and career pathways.

Broadband Employer Listening Sessions

The division held two virtual employer listening sessions in June 2023, attended by 15 participants. The goal of the sessions was to learn directly from employers and the collective bargaining organization with a presence in North Carolina about their workforce training needs to complement the occupational analysis.

Areas of inquiry in the listening sessions were: 1) priority broadband jobs and credentials; 2) how companies find and retain employees; 3) existing education programs/partnerships; and 4) efforts to diversify the broadband workforce.

Key Findings from Broadband Employer Listening Sessions

- Priority jobs mentioned by employers confirmed the quantitative analyses, with fiber installation and 'outside plant' construction (trenching & burying cables) emerging as the most frequently mentioned job needs.

- Fiber splicing and aerial applications were the specialized skills mentioned by employers as the most difficult to find.

- Employers mentioned several curricular resources that teach the fundamentals of fiber technologies; however, there has not been galvanization around a specific industry-recognized credential for fiber technicians. Many companies rely on on-the-job or in-house training that is not certified in a way that carries recognition or transfers across employers.

- Employers cited frequency and location of broadband training as a challenge; training that requires traveling a distance is hard for smaller regional employers in particular.

- Some employers mentioned the potential to tap training assets in the state in overlapping sectors, particularly utility linemen training programs at community colleges. Those training facilities may be well situated to adapt to the broadband sector.

- Employers reported limited relationships with community colleges or high school career and technical training programs in the state; however, they see express an interest in growing those connections and would like to hire individuals who already have a credential in the sector.

- Some employers have partnerships with community-based organizations and see an opportunity to expand them to create a more diverse workforce.

- Employers shared they have not done a good job articulating, particularly to young people, what a career in the broadband sector offers. They expressed an interest in promoting the sector by highlighting career advancement opportunities beyond entry-level positions.

Education and Training Capacity Scan

From May to September 2023, the division carried out an education and training capacity scan. It conducted interviews with eight state and community college leaders, two national broadband associations and one employer training provider, leaders from the N.C. Department of Public Instruction (NCDPI), the state's workforce system, and two statewide community-based organizations.

Areas of inquiry for these interviews included: 1) learning for which broadband jobs training is available and to what extent; 2) existing or emerging partnerships with internet service providers; 3) education and training assets from which North Carolina can build; and 4) overall barriers and opportunities within this sector, particularly with respect to creating a more diverse workforce.

Key Findings from the Education & Training Capacity Scan

The capacity scan identified two community colleges in the state that offered short-term training for fiber technicians in recent years: Wilson Community College and Cape Fear Community College. In addition, Catawba Valley Community College, Central Piedmont Community College, and Central Carolina Community College have recently been considering offering fiber technician training.

Additional community colleges (Wake Tech, Western Piedmont Community College, and Roanoke-Chowan Community College) have previously offered telecom courses, but not in the last three years.

The capacity scan also identified two-degree programs potentially related to the broadband sector: Guilford Tech's Wireless Communications Certificate within electronics degree and Central Carolina Community College's Laser & Photonics Technology program. These could be pathways for students seeking to advance their career in the sector.

The capacity scan revealed **barriers** to implementing more training capacity in the broadband sector:

- Start-up and ongoing training costs are high. Education partners shared estimates of $200,000 to $250,000 to outfit a lab, and there are additional expenses for "consumable" materials used by trainees that must be replenished for each cohort.

- Some education partners cited difficulty finding enough journeymen to support apprenticeship programs.

- Finding qualified instructors to teach fiber technicians is a significant and widespread concern. College wages are not competitive with industry salaries making it difficult to hire individuals who could be working in the sector. Education partners view partnerships with employers to obtain qualified instructors as a critical success factor for broadband training.

- Some education partners shared concerns about the uncertainty of future demand for jobs in this sector.

The education and training capacity scan also revealed **opportunities** to boost the talent pipeline for the broadband sector.

- There are opportunities to leverage broadband training needs with the needs of other sectors such as utility linemen training, as well as emerging sectors such as electric vehicle charging.

- Education partners cited the opportunity to create non-credit to credit pathways into degree programs to build a stronger overall talent pipeline for the sector and career advancement opportunities for those who start with short-term credentials.

- North Carolina has a strong community college system and experience creating regional training hubs such as, for example, the biotech manufacturing sector.

- North Carolina has robust dual enrollment policies that enable partnerships between high schools and community colleges to develop career pathways and transitions for students and recent high school graduates.

- At least one statewide community-based organization has already explored potential training for this sector. This partner has a strong record of supporting students from diverse backgrounds to success in job training programs.

Collaboration with Partners

North Carolina's approach to ensuring it has the workforce needed to successfully deploy broadband relies on strong collaboration with partners. This section of the plan describes current and planned collaborations with key partners to achieve the state's workforce goals for this sector.

N.C. Department of Commerce: The state's strategic economic development plan, First in Talent: Strategic Economic Development Plan for the State of North Carolina prioritizes broadband as critically important to the state's economic future and aligns with this workforce plan. The executive director of the NCWorks Commission is a member of the broadband workforce advisory committee. In addition, the division contributed to the state's 5-year Workforce Innovation and Opportunity Act plan so it includes language about how the Commission will support the broadband sector. Division leaders also met with commerce staff who lead the agency's economic development; business services; rural development; and diversity, equity, and inclusion programs.

N.C. Community Colleges: To assist in the development of this plan, eight community college representatives were interviewed, and three leaders are members of the state's broadband workforce advisory committee. The state solicited information from partners about their training expertise and the costs associated with broadband training, particularly fiber technicians. As described below, this plan will create regional training hubs for this sector in partnership with the N.C. Community College System and local community colleges. In addition, the community college system disburses funding through its Short-Term Workforce Grant program for industry-valued, non-degree credentials (identified as NC Workforce Credentials) that may be available to support broadband training.

N.C. Department of Public Instruction (NCDPI): NCDPI's lead on workforce engagement is a member of the advisory committee and the state's Career & Technical Education (CTE) director contributed to the capacity scan. These leaders identified opportunities to create local partnerships between community colleges, CTE programs, and employers to recruit more young people into the broadband sector, as described later in the plan.

N.C. Business Committee for Education (NCBCE): NCBCE provides a critical link between North Carolina business leaders and the state's education decision makers. NCBCE is helping lead efforts to expand training capacity in clean energy through the federally supported STEPs4Growth initiative. The state will explore crossover training needs and capacity—particularly related to growing the state's network of Electric Vehicle charging stations—and broadband deployment.

Aligned Funders: The division identified aligned funders poised to support the implementation of this workforce plan.

Fiber Broadband Association: A workforce leader from this national association is a member of the advisory committee and shared expertise on training credentials and costs to inform this plan. As the state implements the plan, engagement will continue.

Wireless Infrastructure Association: A workforce leader from this national association is a member of the advisory committee and shared expertise on training credentials and costs to inform this plan. As the state implements the plan, engagement will continue.

Communications Workers of America: A North Carolina leader of this collective-bargaining organization is a member of the advisory committee and participated in listening sessions to inform this plan. As the state implements the plan, engagement will continue.

Internet Service Providers and Fiber Manufacturers: Throughout the workforce plan's development, industry representatives participated through advisory committee representation, employer listening sessions, interviews, and an employer panel focused on workforce at the state's Internet for All forum held in May 2023.

North Carolina's Broadband Workforce Vision and Goals

North Carolina's BEAD workforce vision is to support a high quality, diverse workforce to effectively deploy universal broadband access across the state. Goals include:

1. Develop strategies to bolster the estimated 6,100 broadband jobs that will be created between
   2024-2028.
2. Create a more diverse broadband workforce through the development of job quality and equity measures that can be used to set collaborative goals for broadband-related training.
3. Ensure workforce standards and federal employment requirements are satisfied in all subgrantee contracts.
4. Create a career pathway for the broadband sector that will communicate on-ramps and career advancement opportunities in the sector.
5. Develop fiber technician training capacity in at least three North Carolina community colleges that results in at least 630 credentialed fiber technicians.
6. Support broadband summer learning opportunities for high school students.

7. Continue the state's current broadband workforce advisory committee to act as a sector partnership that will continue to inform strategies and track progress toward the state's workforce goals.

Setting a Pathway to Achieve Broadband Workforce Goals

The division will undertake the following strategies to support achieving the state's broadband workforce goals.

Enforce Workforce Standards & Federal Employment Requirements

The division is committed to ensuring that all subgrantees align with its strategic objectives and core values, particularly in the areas of labor standards and safeguarding workers. In selecting prospective subgrantees, the division will follow a structured application and contracting process that ensures that it partners with entities that share its commitment to labor compliance. The subgrantee evaluation process will be tailored to meet the NOFO requirements, helping to ensure compliance with state and federal labor and employment laws throughout the phases of BEAD projects. Additional details are available in the Labor Standards and Protections section of the Initial Proposal.

Create a career pathway to map on-ramps to entry-level broadband jobs and career advancement opportunities.

The division asked the NCWorks Commission and the Piedmont Triad Regional Workforce Development Board to lead efforts to create a career pathway for the broadband sector that will recruit a more robust and diverse workforce to the sector. Located in the central part of the state, this workforce board has experience partnering with the broadband sector and education and community-based partners.

The development of the career pathway will follow national best practices, including: engaging with employers and education partners to map broadband sector entry-level jobs and training programs, identifying on-ramps for those jobs as well as career advancement opportunities; embedding stackable credentials within the pathway that lead to degree programs; creating strong visuals that illustrate the pathway in terms of jobs, wages, and job requirements; and developing template communication and marketing assets that use clear and culturally-responsive messaging that resonates with diverse populations. The career pathway will be adapted for use in other parts of the state by other workforce boards and education partners to aid in creating more on-ramps to the sector and improving digital literacy within the workforce.

Develop regional training hubs at community colleges to offer fiber technician credentials.

North Carolina has 58 community colleges, one of the strongest and largest systems in the nation. The N.C. Community College System will lead efforts to establish additional fiber technician training at its colleges. The labor market analyses and employer listening sessions conducted for this plan indicated that pre-employment training through community colleges will be a key factor to boost the talent pipeline and to create a more diverse workforce. More specifically:

- The N.C. Community College System will lead a process to engage with colleges to identify sites for augmented/new broadband training programs. They will be selected based 1) geographic diversity across the state, 2) partnerships with employers, 3) ability to create lab

space required for the training; and 4) in some cases, leverage training for other sectors that may use some of the same equipment and expertise. The system has a track record of doing similar work for other sectors, such as the biotech manufacturing sector.

- Regional training hubs supported by this plan will primarily offer short-term entry-level fiber technician credentials that focus on safety, quality installation, and industry value. Priority will be given to credentials on the state's "credentials of value" list. NC Workforce Credentials are priority, non-degree credentials identified by the state that lead to family sustaining-wage careers as identified by a cross sector partnership between the Department of Commerce, Department of Public Instruction (DPI), and NC Community Colleges. Credentials can be submitted for consideration and are added on a quarterly basis if validated and recommended by a statewide advisory council. Inclusion on the list also opens no-cost pathways for some students to earn the credential through financial aid for short-term credentials provided by the state under the Short-Term Workforce Grants program funded by the state legislature.

- Based on input from the education and training capacity scan, training cohorts should average 10 individuals. This plan anticipates each training hub will run between three and five training cohorts per year, with a total goal of 630 certified fiber technicians completing over the five-year grant.

- Training hubs will also be available to broadband employers for post-employment training through, for example, incumbent workforce training resources offered by the N.C. Department of Commerce and the N.C. Community College System and in partnership with employers seeking additional skilling and re-skilling needs.

- The hubs will also seek to offer and/or connect individuals to utility locating training and certifications given the importance of identifying buried infrastructure prior to broadband deployment.

- **Employers' roles**: Securing qualified instructors to prepare fiber technicians is a challenge because state instructional salaries are not competitive with those of industry. This plan calls for industry partners to be central partners in identifying or providing instructors to teach the training courses. For example, recent retirees or contractors are often excellent instructors. North Carolina expects industry to be strong partners in fulfilling this component of the state's broadband plan. In addition, some employers may have physical facilities and consumable training materials that could be in-kind contributions. Articulating how a company will support the creation of a high quality and diverse broadband workforce by identifying instructors and providing in-kind contributions to regional training hubs will be a component of broadband deployment proposals.

- Establishing and operating three training hubs over the five years will cost approximately $2.2 million. (See budget in Appendix B.) This estimate includes start-up equipment and curricular costs, project management, instructor costs, training consumables, and tuition support for half of trainees. The N.C. Community College System will use BEAD planning funds to hire a community college-based project manager and lead instructor to coordinate the hubs and to train additional instructors in a train-the-trainer model.

Support a diverse workforce for the broadband sector.

The division will partner with community-based organizations to recruit and support diverse populations to complete fiber technician training at the regional community college training hubs described earlier. In partnership with employers, community-based organizations will 1) use the communications assets created as part of the career pathway development process, recruit students from underrepresented groups, including Black, Latino and female residents, 2) as needed, provide training stipends, career readiness skills, and holistic supports such as child care vouchers, transportation, and emergency assistance, 3) offer case management services so that students have frequent and supportive connection to assistance from someone who can help them navigate supports they need in order to successfully complete their training.

These are the evidence-based strategies needed to ensure equitable access to and completion of training programs that will ensure the state meets its target for individuals entering the broadband sector as credentialed fiber technicians with access to continued career advancement.

The division engages with two community-based organizations— El Centro Hispano and the Urban League of Central Carolinas, both of which have representation on the broadband advisory committee—and will continue to partner with them to implement the plan.

The estimated cost for these strategies is $967,000 over the five-year period. One potential funding source for this portion of the plan is NextGen training dollars for opportunity youth, which are federal funds managed by workforce boards across the state. Other Workforce Innovation and Opportunity Act funds may also be used to support individuals in broadband training programs. In addition, collaborators may seek philanthropic support to fund this portion of the workforce plan, especially the holistic support and case management services.

Partner with school districts to create Career Accelerators and dual enrollment on-ramps to the broadband sector.

Using pandemic relief funds, the N.C. Department of Public Instruction (DPI) developed summer Career Accelerators to connect high school students to career opportunities through evidenced-based, high quality experiences. NCDPI will explore establishing a Career Accelerator training for rising senior and/or recent high school graduates at each of the regional training hubs at community colleges starting summer of 2024. Additional planning will take place in 2024 to determine if high school students are ready to complete the full fiber technician credential as part of the Career Accelerator or whether they will take an introductory curriculum that prepares them to later complete the full certification.

North Carolina has strong dual enrollment programs and funding support that enable many opportunities to earn college credit while in high school. Non-credit pathways are included in the state's dual enrollment framework, and NCDPI and the N.C. Community College System will work with local partners to establish a Career and College Promise pathway for each of the regional training hubs.
Similar to the regional training hubs, implementing plans for the Career Accelerators and dual enrollment pathways will require partnerships with broadband employers to identify and support qualified instructors to teach these programs.

Funding support for dual enrollment opportunities comes from the state's Career and College Promise funding program. There are also remaining pandemic relief dollars to support Career

Accelerators in the summer 2024. After that, NCDPI and the division will look for sustainability partners to continue the program.

Promote pre-apprenticeships and apprenticeships.

There are currently pre-apprenticeship and apprenticeship programs in North Carolina for this sector, some of which are registered with the U.S. Department of Labor. The division will encourage the N.C. Apprenticeship Office in the N.C. Community College System to promote these opportunities and look for opportunities to support their growth and development, particularly connecting more diverse candidates to these opportunities. Another area of emphasis will be encouraging employer partners to identify journeymen to support apprentices in the workplace.

Create a sector partnership to continue to support and monitor progress toward goals.

The division will explore the feasibility of the NCWorks Commission continuing to convene the advisory committee in 2024 as a sector partnership to drive and support implementation of the workforce plan. The advisory committee includes representation of labor organizations and community-based organizations to maintain worker voice throughout the planning and implementation process. The division will continually engage with this advisory committee, including stakeholders representing labor organizations and community-based organizations.

The composition of the committee comprises all the stakeholders needed for a sector partnership: employers, education partners, policymakers, labor organizations, and community-based organizations. The role of the committee will be to:

- align partners as the workforce plan is implemented;
- showcase workforce wins that can be emulated across the state;
- assess progress toward goals (see evaluation plan below) and refine strategies as needed, including any new opportunities that emerge; and
- develop a structure that may be sustained by partners beyond the parameters of the BEAD grant.

Initial focus of the advisory committee will be to:

- develop a resource/funding plan to implement key workforce plan components,
- help design and vet employer-led training curricula and credentials for the training hubs, and
- increase career awareness for the broadband sector.

The division will collaborate with the NCWorks Commission to determine the funding support necessary to take on this role.

Monitoring and Evaluation Plan

The division will annually evaluate progress on the workforce plan goals as part of its Key Performance Indicators. The evaluation will focus on the goals and metrics set out earlier in the plan. When it comes to the broadband-specific training offered through the regional training hubs described previously, the division will track traditional workforce development measures, job quality measures, and workforce equity measures.

Traditional Workforce Development Measures

For training offered through the regional training hubs, the state will collect and track the traditional workforce development measures used for the Workforce Innovation and Opportunity Act (WIOA). The six core measures for adults are the following: 1) employment rate in the second quarter after program exit; 2) employment rate in the fourth quarter after program exit; 3) median earnings in the second quarter after program exit; 4) credential attainment; 5) measurable skills gains; and 6) effectiveness serving employers.[57]

Using the core WIOA measures as a starting point will allow for the drawing of comparisons with existing workforce development programs. It also will help with program administration, as public agencies in North Carolina already have data tracking and reporting systems designed to capture that information. The use of such measures also will facilitate the use of any additional training funding that may be provided for broadband-related training from the NCWorks Commission.

Job Quality Measures

While traditional workforce development measures are uniform and standardized, they do not capture the quality of the jobs that program participants obtain.[58] Yet job quality plays an essential role in determining whether a worker advances economically, commits long term to an employer, remains in a specific occupation, and continues to participate in the labor market.

In the process of developing the regional training hubs, the division will work with its training partners to develop and track performance indicators related to job quality. The general approach will be inspired by the job quality framework used by the Organization for Economic Co-Operation and Development (OECD)—a framework that uses multiple measures to assess three areas: earnings quality, labor market security, and workplace environment.

Given the limitations of existing performance reporting systems used in North Carolina, it may not be possible to apply the OECD framework directly, but by developing versions of these measures as part of the design process will allow for BEAD funding to help catalyze larger changes in how North Carolina assesses the success of workforce development programs.

Workforce Equity Measures

As noted previously, the current workforce in the broadband sector does not mirror the diversity of the state's larger workforce or population. At the same time, many existing data sources related to the labor market and workforce development programs do not capture enough data to meaningfully assess the equity impacts of various interventions. In the process of standing up the regional training hubs, the division will work to ensure that data systems capture the demographic information from participants needed to formulate equity goals, steer outreach, and track progress toward those ends. This will involve designing intake forms to capture key data like age, race/ethnicity, gender, geography, receipt of public assistance, limited English proficiency, and veteran status.

Once the division and its training partners establish what kinds of participant data can be collected, they then can work with the advisory committee to establish equity goals that could be achieved, such as setting targets for the number of women entering the broadband sector. A collaborative process will ensure that the selected metrics are shared by the state, training institutions, and industry, which will ensure that progress toward them can be made.

Appendix A

NC Broadband Workforce Advisory Committee
October 2023

Name	Organization / Company
Alan Fitzpatrick	Open Broadband
Amelia DeJesus	Wireless Infrastructure Association
Andrea DeSantis	Governor Cooper's Policy Team
Andrew Gardner	NC Community Colleges
Annie Izod	NCWorks Commission, NC Department of Commerce
Debbie Kish	Fiber Broadband Association
Gary Beasley	Central Carolina Community College
Jennifer Tracy	Spectrum/Charter
John Chamberlain	Commscope
Keith Busby	Communication Workers of America
Kim Shepherd	SkyLine
Kristie Van Auken	NC Department of Public Instruction
Mauricio Solano	El Centro Hispano
Maya Norvel	Corning
Michelle Slaton	Piedmont Triad Workforce Development Board
Robert Doreauk	AT&T
Robyn Hamilton	Urban League of the Carolinas
Shinica Thomas	Wake County Commissioner
Wade Boteler	National OnDemand, Inc.
Wes Hill	Wilson Community College

Appendix B

Costs per Training Hub	Startup costs	Costs per cohort	2024	2025	2026	2027	2028		
			3 cohorts x 3 hubs	5 cohorts x 3 hubs	5 cohorts x 3 hubs	5 cohorts x 3 hubs	3 cohorts x 3 hubs		
Equipment / set-up costs (one-time; 3 training hubs)	$600,000								
Curriculum license (one-time; covers 5 years)	$80,000								
Project manager / lead instructor (1 FTE + benefits)			$75,000	$100,000	$100,000	$100,000	$100,000		
Instructor costs		$9,000	$81,000	$135,000	$135,000	$135,000	$81,000		
Tuition support ($750/student @ 5 students/cohort)		$3,750	$33,750	$56,250	$56,250	$56,250	$33,750		
Consumables (average cohort size of 10)		$4,000	$36,000	$60,000	$60,000	$60,000	$36,000		
Recruitment		$1,000	$3,000	$5,000	$5,000	$5,000	$3,000		
	$680,000		**$228,750**	**$356,250**	**$356,250**	**$356,250**	**$253,750**	**Total**	**$2,231,250**
Costs to Support Diversity Strategies									
Holistic supports (transportation, childcare, etc.) for average of 3 students/cohort)		$1,800	$16,200	$27,000	$27,000	$27,000	$16,200		
Stipend for 3 students per cohort (144 hours x 15/hr. x 3)		$6,480	$58,320	$97,200	$97,200	$97,200	$58,320		
Safety equipment (average of 3 students/cohort)		$1,200	$10,800	$18,000	$18,000	$18,000	$10,800		
Career readiness training (average of 3 students/cohort)		$600	$5,400	$9,000	$9,000	$9,000	$5,400		
Recruitment			$1,500	$1,500	$1,500	$1,500	$1,500		
Case management (1 FTE + benefits)			$65,000	$65,000	$65,000	$65,000	$65,000		
			$157,220	**$217,700**	**$217,700**	**$217,700**	**$157,220**	**Total**	**$967,540**

[1] U.S. Department of Commerce, "Biden-Harris Administration Announces State Allocations for $42.45 Billion High-Speed Internet Grant Program as Part of Investing in America Agenda," news release June 26, 2023, https://www.commerce.gov/news/press-releases/2023/06/biden-harris-administration-announces-state-allocations-4245-billion; and NCDIT Division of Broadband and Digital Equity, *BEAD Program Five-Year Plan: Draft for Public Comments*, 3.
[2] America Achieves and Rural Innovation Strategies, *Creating and Expanding a Diverse Broadband Workforce with Good Jobs and Career Pathways: Broadband Equity, Access, and Deployment (BEAD) Program Playbook for Eligible Entities* (New York: America Achieves, 2022), 24.
[3] John Quinterno, *Running the Numbers: A Practical Guide to Regional Economic and Social Analysis* (New York: Routledge, 2014), 135.
[4] Quinterno, *Running the Numbers*, 154.
[5] U.S. Census Bureau, "North American Industry Classification System: Frequently Asked Questions," accessed June 4, 2023, https://www.census.gov/naics/.
[6] U.S. Census Bureau, "North American Industry Classification System: Frequently Asked Questions."
[7] The NAICS defines the "Information" sector (NAICS: 51) as comprising "establishments engaged in the following processes: a) producing and distributing information and cultural produces, b) providing the means to transmit or distribute these produces as well as data or communications, and c) processing data." The more detailed "Telecommunications" subsector (NAICS: 517) consists of establishments that are "primarily engages in operating and/or providing access to facilities for the transmission of voice, data, text, sound, and video." The even more detailed Wired and Wireless Telecommunication (except Satellite) industry (NAICS: 51711) "comprises establishments primarily engaged in operating, maintaining, and/or providing access to switching and transmission facilities and infrastructure that they own and/or lease for the transmission of voice, data, text, sound, and video using wired and wireless telecommunications networks (except satellite)." For more details, see U.S. Census Bureau, *North American Industry Classification System: United States, 2022*, (Washington, DC: Office of Management and Budget, 2022), 401-420.
[8] America Achieves and Rural Innovation Strategies, *Creating and Expanding a Diverse Broadband Workforce*, 6.
[9] Establishments in the Wired and Wireless Telecommunications Carriers industries often contract the installation and maintenance of their telecommunications systems to independent contractors. Those third-party contractors are classified under the larger Construction sector (NAICS: 23). See U.S. Census Bureau, *North American Industry Classification System*, 413.
[10] Robert Pollin, Jeannette Wicks-Lim, Shouvik Chakraborty, and Gregor Semlenluk, *Impacts of the Reimagine Appalachia and Clean Energy Transition Programs for Ohio: Job Creation, Economic Recovery, and Long-Term* Sustainability (Amherst, MA: Political Economy Research Institute, 2020), 107.
[11] The 2020 study by Pollin et al. used the 2017 version of the North American Industry Classification System (NAICS), which was in effect at the time. The updated 2022 version of the system altered some of the categories initially used. More specifically, the "Cable and Other Subscription Programming" detailed industry was combined into a new "Media Streaming, Distribution Services, Social Networks, and Other Media Networks and Content Providers" detailed industry. Similarly, the classification of both the "Wired Telecommunications Carriers" detailed industry and the "Wireless Telecommunications Carriers (except Satellite)" were reorganized and assigned new identifiers. See U.S. Census Bureau, "North American Industry Classification System," last revised July 12, 2023, https://www.census.gov/naics/. Due to the structure of other data used in this landscape analysis, the 2017 NAICS categories are used unless otherwise noted.
[12] All data in this paragraph are from author's analysis of N.C. Department of Commerce: Labor and Economic Analysis Division, Quarterly Census of Employment and Wages, Annual Values, 2021.
[13] All data in this paragraph are from author's analysis of N.C. Department of Commerce: Labor and Economic Analysis Division, Quarterly Census of Employment and Wages, Annual Values, 2021.
[14] Quinterno, *Running the Numbers*, 176.
[15] Quinterno, *Running the Numbers*, 176.
[16] U.S. Census Bureau, "North American Industry Classification System: Frequently Asked Questions," accessed June 4, 2023, https://www.census.gov/naics/.
[17] U.S. Bureau of Labor Statistics, "Standard Occupational Classification and Coding Structure: 2018," accessed June 5, 2023, https://www.bls.gov/soc/2018/soc_2018_class_and_coding_structure.pdf.
[18] Marcela Escobari, Dhruv Gandhi, and Sebastian Strauss, *How Federal Infrastructure Investment Can Put America to Work* (Washington, DC: Brookings Institution, 2021), 15.
[19] America Achieves and Rural Innovation Strategies, *Creating and Expanding a Diverse Broadband Workforce*, 24.
[20] Author's analysis of U.S. Bureau of Labor Statistics, Employment Projections Program: National Employment Matrix: Occupation, 2021, accessed June 7, 2023, https://www.bls.gov/emp/data.htm.
[21] All data in this paragraph are from author's analysis of N.C. Department of Commerce: Labor and Economic Analysis Division, Occupational Employment and Wage Statistics Program, May 2022.
[22] All data in this paragraph are from author's analysis of N.C. Department of Commerce: Labor and Economic Analysis Division, Occupational Employment and Wage Statistics Program, May 2022.
[23] Author's analysis of N.C. Department of Commerce: Labor and Economic Analysis Division, Occupational Employment and Wage Statistics Program, May 2022; and U.S. Bureau of Labor Statistics, Employment Projections Program: National Employment Matrix: Occupation, 2021.

[24] All data in this paragraph are from author's analysis of N.C. Department of Commerce: Labor and Economic Analysis Division, Quarterly Census of Employment and Wages, Annual Values, 2017 and 2021.
[25] All data in this paragraph are from author's analysis of N.C. Department of Commerce: Labor and Economic Division, Occupational Employment and Wage Statistics Program, May 2022; and U.S. Bureau of Labor Statistics, Occupational Employment, and Wages Statistics Program: Research Estimates by State and Industry, May 2018.
[26] All data in this paragraph are from author's analysis of NCWorks Online, accessed June 9, 2023, https://www.ncworks.gov.
[27] All data in this paragraph are from author's analysis of U.S. Department of Labor: Employment and Training Administration, O*NET Online, last updated May 23, 2023; https://www.onetonline.org/.
[28] All data in this paragraph are from author's analysis of U.S. Department of Labor: Employment and Training Administration, O*NET Online, last updated May 23, 2023; https://www.onetonline.org/.
[29] Author's analysis of N.C. Department of Commerce: Labor and Economic Analysis Division, Occupational Employment and Wage Statistics Program, May 2022.
[30] Author's analysis of N.C. Department of Commerce: Labor and Economic Analysis Division, Occupational Employment and Wage Statistics Program, May 2022.
[31] Author's analysis of U.S. Bureau of Labor Statistics, Employee Benefit Survey: March 2022, accessed June 9, 2023, https://www.bls.gov/ebs/home.htm.
[32] Author's analysis of U.S. Bureau of Labor Statistics, Union Membership: 2022, accessed June 9, 2023, https://www.bls.gov/news.release/union2.htm.
[33] Author's analysis of U.S. Census Bureau, Longitudinal Employer-Household Dynamics Program, Quarterly Workforce Indicators, 2022.q3.
[34] Author's analysis of U.S. Census Bureau, Longitudinal Employer-Household Dynamics Program, Quarterly Workforce Indicators, 2022.q3.
[35] Author's analysis of U.S. Census Bureau, Longitudinal Employer-Household Dynamics Program, Quarterly Workforce Indicators, 2022.q3.
[36] Author's analysis of U.S. Census Bureau, Longitudinal Employer-Household Dynamics Program, Quarterly Workforce Indicators, 2022.q3.
[37] Author's analysis of U.S. Census Bureau, American Community Survey, Five-Year Estimates, 2017-2021.
[38] Author's analysis of U.S. Bureau of Labor Statistics, Geographic Profile of Employment and Unemployment, 2021, last revised Jul5, 2022, https://www.bls.gov/opub/geographic-profile/home.htm. Note that the 2021 values were impacted by the economic disruptions linked to the COVID-19 pandemic.
[39] Author's analysis of N.C. Department of Commerce: Labor and Economic Analysis Division, Employment Projections, accessed June 5, 2023, https://www.commerce.nc.gov/data-tools-reports/labor-market-data-tools/employment-projections.
[40] Author's analysis of N.C. Department of Commerce: Labor and Economic Analysis Division, Employment Projections, accessed June 5, 2023, https://www.commerce.nc.gov/data-tools-reports/labor-market-data-tools/employment-projections.
[41] Author's analysis of N.C. Department of Commerce: Labor and Economic Analysis Division, Employment Projections, accessed June 5, 2023, https://www.commerce.nc.gov/data-tools-reports/labor-market-data-tools/employment-projections.
[42] Author's analysis of N.C. Department of Commerce: Labor and Economic Analysis Division, Star Jobs Classification System, 2021-203, accessed June 12, 2023, https://tools.nccareers.org/starjobs/.
[43] Author's analysis of N.C. Department of Commerce: Labor and Economic Analysis Division, Employment Projections, accessed June 5, 2023, https://www.commerce.nc.gov/data-tools-reports/labor-market-data-tools/employment-projections; and U.S. Bureau of Labor Statistics, Employment Projections Program: National Employment Matrix: Occupation, 2021.
[44] Author's analysis of N.C. Department of Commerce: Labor and Economic Analysis Division, Employment Projections, accessed June 5, 2023, https://www.commerce.nc.gov/data-tools-reports/labor-market-data-tools/employment-projections.
[45] Author's analysis of N.C. Department of Commerce: Labor and Economic Analysis Division, Employment Projections, accessed June 5, 2023, https://www.commerce.nc.gov/data-tools-reports/labor-market-data-tools/employment-projections.
[46] Author's analysis of N.C. Department of Commerce: Labor and Economic Analysis Division, Employment Projections, accessed June 5, 2023, https://www.commerce.nc.gov/data-tools-reports/labor-market-data-tools/employment-projections.
[47] Quinterno, *Running the Numbers*, 44-46.
[48] Quinterno, *Running the Numbers*, 44-46; and Escobari, *How Federal Infrastructure Investment Can Put America to Work*, 12-13.
[49] Escobari, *How Federal Infrastructure Investment Can Put America to Work*, 12.
[50] The exact grant award to North Carolina is $1,532,999,481; U.S. Department of Commerce, "Biden-Harris Administration Announces State Allocations for $42.45 Billion High-Speed Internet Grant Program."
[51] The exact breakdown of additional federal funding is as follows: $350,000,000 in Growing Rural Economies with Access to Technology (GREAT) grant funds, $400,000,000 in Continuing Access to Broadband (CAB) program funds, $100,000,000 in Broadband Pole Replacement funds; and $86,522,303 in Stop-Gap Solutions funding; see NCDIT Division of Broadband and Digital Equity, *BEAD Program Five-Year Plan: Draft for Public Comments*, 2, 8, and 12.
[52] Escobari, *How Federal Infrastructure Investment Can Put America to Work*, 14.
[53] Escobari, *How Federal Infrastructure Investment Can Put America to Work*, 14.

[54] Escobari, *How Federal Infrastructure Investment Can Put America to Work*, 14.
[55] Escobari, *How Federal Infrastructure Investment Can Put America to Work*, 14.
[56] Author's analysis of U.S. Bureau of Labor Statistics, Geographic Profile of Employment and Unemployment, 2021, last revised Jul5, 2022, https://www.bls.gov/opub/geographic-profile/home.htm. Note that the 2021 values were impacted by the economic disruptions linked to the COVID-19 pandemic.
[57] For as summary of those measures and their calculation, see U.S. Department of Labor, "WIOA Performance Indicators and Measures," accessed October 22, 2023, https://www.dol.gov/agencies/eta/performance/performance-indicators.
[58] For a detailed discussion of the limits of WIOA performance measures, see Livia Lam, *A Design for Workforce Equity: Workforce Redesign for Quality Training and Employment: A Framing Paper* (Washington, DC: Center for American Progress, 2019), https://www.americanprogress.org/article/design-workforce-equity/.