4 Improving broadband connectivity and access to education in the United States

This chapter analyses the main challenges and opportunities to improve broadband connectivity as well as accessibility to quality education to foster rural innovation in the United States. The chapter begins with the assessment of the state of connectivity in the United States, identifying key challenges and opportunities to improve broadband connectivity to boost innovation in rural areas. The chapter ends with an assessment and overview of the measures to improve rural education in the United States.

Key messages

Broadband connectivity

- While rural communities across the United States have distinct demographic features and diverse challenges to foster rural innovation, one common denominator is the ambition and need for high-quality broadband services.
- The United States Government has recognised the importance of broadband connectivity for all segments of the population, regardless of where they live, notably through the Infrastructure Investment and Jobs Act (IIJA) of 2021, which allocates USD 65 billion to bridge digital divides by expanding broadband infrastructure and funding digital equity and inclusion programmes.
- As the digital transformation takes hold, the demand for high-quality broadband services has increased in the United States (e.g. Gigabit fixed broadband subscriptions more than quadrupled from 2019 to 2021). While cable remains the predominant broadband access technology, there is a recent and welcomed push to expand fibre deployments in the country, in which fibre grew by 40.3% from 2020-21, compared to an OECD average growth of 18.6%.
- There are persistent and substantial territorial gaps to high-quality broadband access among urban, rural and Tribal Land areas in the United States. In terms of broadband coverage, 20.9% and 22.1% of the rural and Tribal Land population, respectively, lived in areas without coverage of fixed broadband offers at 100 Mbps download speeds in June 2021. Moreover, even if they are covered, they often only have the choice of one provider. Broadband adoption rates reveal even starker contrasts. In terms of experienced speeds, there is a 51-percentage point gap in download broadband speeds experienced by users in urban (metro) compared to rural regions by state.
- To avoid deepening existent digital and economic divides, access to high-quality broadband at affordable prices in rural areas of the United States is paramount. To address this priority, the United States has a myriad of programmes. The impact of such initiatives could be amplified, for example, by measures that reduce broadband deployment costs, where local authorities are key stakeholders. Policies addressing affordability from the consumer side also play a role, e.g. the Affordable Connectivity Program (ACP).
- The implementation of recent broadband funding initiatives highlights that all levels of government acknowledge the importance of addressing connectivity gaps. These programmes also have an important role to play in shaping broadband policies in the United States. For example, the funding rules of one of the main projects from the IIJA sought to boost competition and incentivise investments in “future proof” technologies, which are laudable developments. Close collaboration across agencies and levels of government should increase the impact of such measures.

Access to education

- In rural communities, education services are more expensive and often suffer from quality concerns. The limited quality and capacity of local governments to deliver education services is rooted in the territorial challenges of the region, whereby lower density makes services less cost efficient and staffing challenges are persistent.
- Strengthening the early (K-12) education system can be a turning point for rural communities. Ensuring access to quality education from an early age can help engage youth to reinvest in their communities.

- Higher education institutions have a role to play in promoting innovation, but the offer of services they provide need to be aligned with the demand in the market and resources available. This includes communities going through demographic and economic transition, and in particular in communities with a strong portion of Indigenous populations.
- Skills shortages are one of the largest challenges that rural communities face and is a problem that often starts from early education. These issues are exacerbated by the fact that communities struggle to recruit teachers and provide them with certification opportunities or well targeted skills training programmes (e.g. vocational training). Investing in vocational education in rural areas should be a priority to enable more diverse training options.
- Finally, encouraging entrepreneurial activities in rural areas is critical for innovation. Providing skills training, guidance and new partnership opportunities to develop those skills can create new opportunities for rural communities.

This chapter focuses on two key framework conditions that are particularly important for rural innovation, which are access to broadband connectivity and access to education. Innovation is a function of human and capital inputs. It is impacted by access to resources that can ensure the smooth functioning of innovation across all geographical locations. Innovation presents itself in a different way in rural towns compared to other geographical areas, as it may also relate to processes rather than products or services, such as finding creative or innovative solutions to more binding constraints than those found in urban counterparts.

Without solid enabling framework conditions, building the opportunities for innovation can be challenging. Access to basic government services is more limited in non-metropolitan and rural counties than in metropolitan counties (OECD, 2021[1]). As demographic change takes place, sparsely populated areas face higher costs for service delivery in basic public services such as education and health (OECD/EC-JRC, 2021[2]).

Broadband connectivity to boost rural innovation

Rural areas have a higher proportion of population without access to Internet or with limited digital literacy skills, also known as the digital divide. Barriers to broadband uptake in rural and remote areas are many and varied, including the high cost of serving rural areas coupled with lack of competitive offers. While access and affordability can also be an issue in urban areas, in rural areas where broadband services are available, there is often limited or no choice among Internet Service Providers (ISPs), and rural residents typically have access to a lower-level quality of service than what is available in urban areas (OECD, 2018[3]). In an increasingly connected world, this pronounced digital divide between urban and rural areas further hinders the prospects for innovation and development in rural communities (OECD, 2021[4]). Bridging connectivity divides, or gaps in access and uptake of high-quality broadband services at affordable prices,[1] is a policy priority for the United States. The different programmes adopted by the government to achieve this goal will be further delineated in the chapter.

Setting the scene: The importance of connectivity for the digital transformation

Ubiquitous access to high quality broadband services at affordable prices is key for an inclusive digital transformation of the United States. Individuals, businesses, and governments need reliable and widespread broadband services to benefit from the opportunities that the digital age can offer. Broadband infrastructure is the invisible thread across all sectors of the economy. It underpins the use of digital technologies, and it is crucial for an increasingly 'remote economy', where more and more business processes move online, and people increasingly work and learn from home.

The COVID-19 pandemic has further accentuated the essential role of connectivity and increased the demand for high-quality broadband networks. In the space of just one year (2019-20), Internet traffic exchanged at Internet Exchange Points (IXPs) soared by more than 58% on average in the OECD area and grew by 52.3% in the United States (OECD, 2022[5]). To place this into context, between December 2019 and March 2020, bandwidth exchanged at IXPs in OECD countries increased by 22.3%, more than four times that of the prior quarter (OECD, 2020[6]).

The United States government has recognised the importance of broadband connectivity for all segments of the population, regardless of where they live.[2] To close connectivity divides, broadband infrastructure was set as a fundamental element for the economic recovery package, notably through the Infrastructure Investment and Jobs Act (IIJA), which allocates USD 65 billion to expand broadband infrastructure and stimulate adoption and digital equity programmes. Concerning this piece of legislation, the White House press release states:

> *"More than 30 million Americans live in areas where there is no broadband infrastructure that provides minimally acceptable speeds – a particular problem in rural communities throughout the country. […] The Bipartisan Infrastructure Law will deliver $65 billion to help ensure that every American has access to reliable high-speed internet through a historic investment in broadband infrastructure deployment." (The White House, 2021[7])*

Expanding high-quality broadband connectivity in rural areas of the United States can have important positive externalities across economic sectors and help overcome "the tyranny of the distance" of these communities (i.e. the geographical isolation in the form of distance or transport costs to commodities or infrastructure). It allows people in these communities to have remote access to opportunities and services, such as health, education, banking, and government services.

Broadband connectivity is also a necessity to prepare rural economies to embrace the digital transformation and aid them in disaster relief and emergencies, which in turn increases their resilience and productivity. This could contribute to the regional appeal of rural communities, for example by attracting private sector investments or encouraging regional mobility.

Broadband connectivity has an additional, important role to play in rural areas to boost rural innovation for both digital entrepreneurs as well as traditional firms embracing digitalisation. As explored by academic literature, broadband adoption can enhance a firm's propensity to engage in trade and increase firm scale (Kneller and Timmis, 2016[8]). A recent paper found causal evidence[3] of positive effects of universal broadband policies that may lead to economic benefits for firms in rural areas, in particular, in knowledge-intensive sectors, by exploiting geographical discontinuities in broadband availability across the United Kingdom (DeStefano, Kneller and Timmis, 2022[9]). Other academic work has investigated the relationship between broadband availability, the use of cloud computing and various types of innovation for firms in the United States (Wojan, 2022[10]). Moreover, a working paper from the same author found causal links of the enabling effect of cloud computing on firm innovation in the United States. The results provide concrete evidence of the adverse effects of the geographical digital divide on businesses (Han, Wojan and Goetz, 2023[11]).[4] Therefore, measures that seek to improve access to communication networks and services in rural regions are crucial to foster productive opportunities for small and medium-sized businesses.

Going "rural" in the United States: Access to broadband to boost rural innovation, a bottom-up perspective

The National Association of Development Organizations of the United States highlights an often-said quote, "If you've seen one rural town, you've seen one rural town" (Schwartz, 2012[12]). It points to how rural towns are different, for example, in terms of resources, constraints and distinctive solutions to overcome limitations that may lead to innovation. At the same time, rural communities face common challenges, notably distance to markets, services, and lack of density needed for the economic benefits of agglomeration. The rural communities visited for the field research of this project all shared the common plea and eagerness to be connected to high-speed broadband networks.

Broadband networks are perceived as essential infrastructure in rural communities for a myriad of reasons. These reasons range from enabling entrepreneurs to reach international markets while living in a rural community, to becoming attractive for younger generations so that they stay and live in these communities and foster their development, to accessing high-quality remote education and health services, among many others. The following case studies highlight the demand for broadband and existing challenges in rural communities of the United States (Box 4.1).

Box 4.1. The importance of broadband access to enhance rural innovation in the United States

The three towns visited for the field research of this project present different demographic features (see Annex 4.A for detailed census indicators) and often face diverse challenges to foster rural innovation; however, they shared the common ambition of enhancing broadband connectivity.

Gallup, New Mexico

Gallup is an accessible rural town in McKinley County. It is located on the outskirts of Navajo Nation, a Native American reservation, and surrounded by 22 "Pueblos".[5] According to 2020 census data, Gallup had 21 495 inhabitants in 2021, with 47.7% identifying as American Indian/Alaska Native,[6] 30.6% as Hispanic or Latino, and 18.9% as "white" (not Hispanic or Latino). The percentage of households with a broadband Internet subscription in the 2016-20 period was 68.3%. The annual per capita household income for the same period was USD 21 231 (U.S. Census Bureau, 2022[13]).

The geographical placement of Gallup is within a "checkerboard" of different land property rights (e.g. Tribal Trust Land, Navajo Nation land, and "lati" or family land), rendering infrastructure deployment very challenging. Internet Service Providers (ISPs) in Gallup underscore that navigating the access to rights of way and construction permits are the main roadblocks to deploying broadband infrastructure (as well as other utilities). For example, one ISP deploying fibre declared that it took roughly seven years to clear the rights of way process to be able to deploy fibre along the Interstate 40 corridor from Albuquerque to Gallup (i.e. a two-hour drive).

Notwithstanding these challenges, Gallup's residents seemed determined to expand infrastructure through what they call "Private Public and Tribal" partnerships. The Northwest New Mexico Council of Governments (NWNMCOG) is strongly engaged to promote infrastructure deployment projects, including broadband. In 2013, a large section of private land of 40 sq. miles (103.6 sq. km) became available, and a private entity interested in the economic development of the city (Gallup Land Partners) purchased it with the intent of engaging in a private public partnership (PPP) with local governments. The projects range from building new neighbourhoods, new industrial parks, connected highways, to a hospital.

The town of Gallup also provides basic infrastructure and services to Navajo Nation inhabitants who travel to buy commodities and access basic services. It also hosts the campus of the University of New Mexico, Gallup. Therefore, fostering broadband access in Gallup also has spillover effects onto Tribal Lands.

Concerning Tribal Lands, Navajo Nation is geographically located between three states: New Mexico, Arizona, and Utah. The Navajo Nation Council, which is the legislative branch of the Nation, has 24 district delegates representing 110 Tribal Chapters. At the end of June 2022, the 24th Navajo Nation Council approved legislation to use USD 1 billion of the American Rescue Plan Act (ARPA) funding the nation had received to promote utility infrastructure deployment projects (water and electric lines), housing projects, and broadband infrastructure deployment (Navajo Nation Council, 2022[14]).

According to BroadbandNow data, there are five fixed-wired residential Internet Service Providers (ISPs) in Gallup. One ISP, Sacred Wind, is engaged in deploying more fibre in the region. For example, it provides high-speed broadband connections to the Navajo Tech Innovation Center, a business incubator, in a neighbouring town. In terms of broadband coverage, according to the Federal Communications Commission (FCC)'s "Fourteenth Broadband Deployment Report", at the end of 2019 only 33.5% of McKinley County rural residents lived in areas where 25 Mbps broadband offers were available, compared to 83.5% in urban areas of the county (FCC, 2021[15]).[7]

Pine Bluff, Arkansas

Pine Bluff, in Jefferson County, is in southeast Arkansas, 42 miles (67.6 km) south of the state capital of Little Rock. According to the 2020 census, it had 40 244 inhabitants in 2021, with 76% of the population identifying as black or African American, and 19.1% as "white" (not Hispanic or Latino). The percentage of households with a broadband Internet subscription in the 2016-20 period was 67%, and the per capita annual income (in 2020 dollars) for the same period was USD 19 240 (U.S. Census Bureau, 2022[13]). Among the top issues highlighted were challenges to deploy infrastructure, which has led to a lack of Internet access in rural communities.

At present, the residents of Pine Bluff are working hard not only to restore their previous economic prosperity,[8] but also to rebuild the town through an economic development project called "Go Forward Pine Bluff". The project was designed through a bottom-up approach, where more than 100 citizens volunteered to meet over a year to develop its vision. The plan encompasses four major pillars: economic development (job creation and retention), government and infrastructure, quality of life and education (Go Forward Pine Bluff, 2017[16]).

Among different action points, the Go Forward Pine Bluff plan aims to rebuild downtown Pine Bluff to make it a hub for innovation and business and to foster infrastructure deployment. For example, the "Generator", located in the downtown area, is an innovation hub that houses a co-working space, a collaborative work space ("maker-space"), and access to digital technologies to promote start-ups and entrepreneurs (Go Forward Pine Bluff, 2022[17]). Three female entrepreneurs who graduated from this innovation hub, as well as the Executive Director of the Generator, highlighted the importance of high-quality broadband for the community's economic development, for example, by enabling entrepreneurship and increasing property values. In particular, the entrepreneurs underscored how vital broadband was for the success of their businesses, either to access global markets or to access digital tools, as well as the role broadband plays to attract businesses and people back into the community, as a revitalised community is important for their respective markets.

More broadly, residents of Pine Bluff emphasised the importance of symmetrical download and upload speeds, coverage, and affordability to achieve meaningful broadband connectivity. However, there is still much to accomplish to bridge the connectivity divide in this community. According to BroadbandNow, there are three fixed-wired ISPs offering residential broadband services in Pine Bluff (BroadbandNow, 2022[18]). In terms of broadband coverage, data from the FCC reveals that at the end of 2019, only 35.1% of rural residents of Jefferson County lived in areas where 25 Mbps broadband offers were available, compared to 79.3% in urban areas of the county (FCC, 2021[15]).[9] At the moment of writing, the FCC was undergoing an overhaul of their broadband map, and therefore, this 2019 figure may overestimate coverage.

Fibre deployment is a top priority for Pine Bluff residents who wish to see their community thrive with entrepreneurs.[10] However, only 4% of Jefferson County residents were connected to fibre in July 2022 (BroadbandNow, 2022[18]). This landscape may improve in the future. In July 2020, the Go Forward Pine Bluff (GFPB) organisation embarked on a United States Department of Agriculture (USDA) funded project (Rural Communities Development Initiative grant) to bring to the town high-speed fibre broadband through a multi-stakeholder approach, and seeking to form a public-private partnership with ISPs (Go Forward Pine Bluff, 2020[19]; Arkansas Democrat Gazette, 2022[20]). However, as of April 2022, GFPB and city officials had not found a partner willing to enter a public-private partnership with the city for high-speed fibre broadband deployment. Regarding business offers (i.e. non-residential broadband), in December 2020, one regional ISP, Ritter Communications, announced a USD 2.8 million investment to cover Pine Bluff business customers with fibre (Ritter Communications, 2020[21]). In June 2021, WEHCO media proposed to invest USD 2.1 million to upgrade existing cable infrastructure to achieve

"gigabit speeds" (i.e. higher than 1 000 Mbps) in Pine Bluff (Arkansas Democratic Gazette, 2021[22]). This announcement may render it difficult for other ISPs in the market to obtain federal funding for fibre.

Columbiana, Ohio

Columbiana is a midwestern town located in northeast Ohio with 6 694 inhabitants, out of which 94.1% of the population identify as "white" (non-Hispanic nor Latino). It was the birthplace of the American entrepreneur, Harvey S. Firestone, founder of Firestone Tire and Rubber Company. The percentage of households with a broadband Internet subscription in the 2016-20 period was 87.1% in the 2016-20 period, and the annual per capita income (in 2020 dollars) for the same period was USD 35 621 (U.S. Census Bureau, 2022[13]).

Columbiana residents underscored the importance of high-quality broadband networks. However, at the county level, fibre-to-the-home (FTTH) was only available to 2% of residents (BroadbandNow, 2022[23]). In terms of broadband coverage, data from the FCC reveals that at the end of 2019, 68.8% of Columbiana County rural residents lived in areas where 25 Mbps broadband offers were available, compared to 97.4% in urban areas of the county (FCC, 2021[15]).[11]

Source: Based on interviews with stakeholders in Gallup, New Mexico, Pine Bluff, Arkansas and Columbiana, Ohio; U.S. Census Bureau (2022[13]), *QuickFacts: Columbiana City, Ohio; Gallup City, New Mexico; Pine Bluff City, Arkansas*, https://www.census.gov/quickfacts/fact/table/columbianacityohio,gallupcitynewmexico,pinebluffcityarkansas/HSG495220#HSG495220; Navajo Nation Council (2022[14]), "$1,070,298,867 Billion in American Rescue Plan Act funding approved for Water Pipelines, Electricity, Housing Construction, and Broadband Internet Projects by the Navajo Nation Council", https://www.navajonationcouncil.org/wp-content/uploads/2022/06/0086-22_2022.06.30.pdf; FCC (2021[15]), *Fourteenth Broadband Deployment Report*, https://www.fcc.gov/reports-research/reports/broadband-progress-reports/fourteenth-broadband-deployment-report; Go Forward Pine Bluff (2017[16]), *A Strategic Plan and Future Direction for the City of Pine Bluff*, https://goforwardpinebluff.org/wp-content/uploads/2023/02/GFPB_Plan.pdf; Go Forward Pine Bluff (2022[17]), *The Generator*, https://goforwardpinebluff.org/the-generator/; BroadbandNow (2022[18]), *Internet Access in Pine Bluff, Arkansas*, https://broadbandnow.com/Arkansas/Pine-Bluff?zip=71601; Ritter Communications (2020[21]), "Ritter Communications invests $2.8 million to bring 100 percent high-speed fiber internet and cloud services to Pine Bluff businesses", https://www.rittercommunications.com/newsroom/ritter-communications-brings-fiber-to-pine-bluff-businesses; Go Forward Pine Bluff (2020[19]), "Team working to bring together fiber internet to Pine Bluff residents and businesses", https://goforwardpinebluff.org/downloads/Pine_Bluff_RCDI_Project_Press_Release_7_2020.pdf; Arkansas Democrat Gazette (2022[20]), "The Generator has been busy, director tells city officials", https://www.arkansasonline.com/news/2022/feb/11/council-mayor-hear-go-forward-initiatives/; Arkansas Democratic Gazette (2021[22]), "WEHCO investment sets up Pine Bluff as 'gig city'", https://www.arkansasonline.com/news/2021/jun/25/wehco-investment-sets-up-pb-as-gig-city/?news-arkansas; BroadbandNow (2022[23]), *Internet Access in Columbiana, Ohio*, https://broadbandnow.com/Ohio/Columbiana?zip=44408.

State of broadband connectivity in the United States

Broadband subscriptions and performance

As the digital transformation takes hold, the demand for high-quality broadband services is increasing across the United States. Broadband users have been upgrading to Gigabit fixed broadband offers (i.e. offers with advertised speeds above 1 000 Mbps) in response to the rise of remote activities. In the two years (2019-21) prior and during the pandemic, the share of gigabit offers over total fixed broadband subscriptions[12] in the United States more than quadrupled, passing from 2.1% to 9.8% (i.e. a 369% increase), which compares to a 134% growth across the OECD over the same period (from 4% in 2019 to 9.4% in 2021) (OECD, 2023[24]).

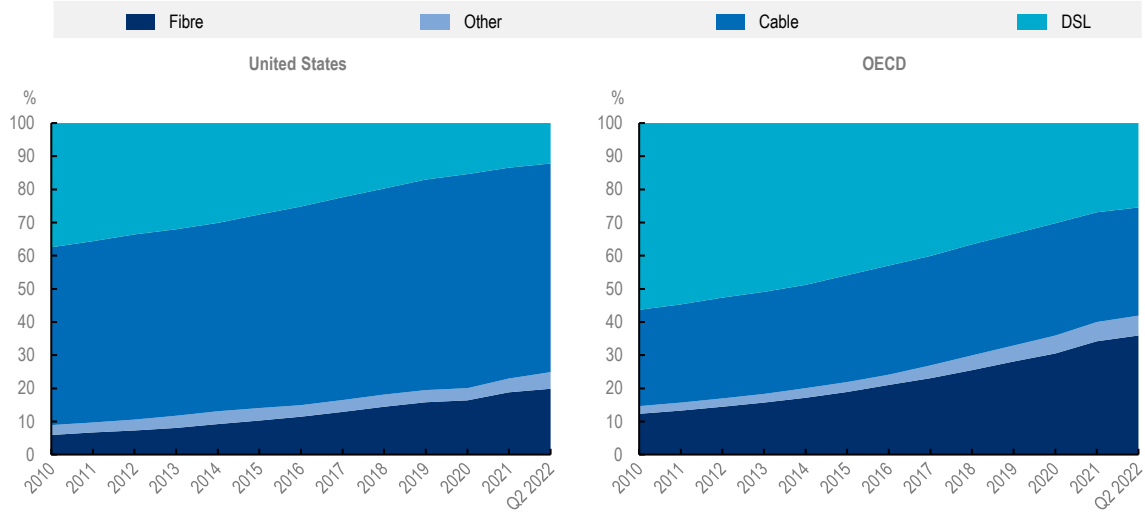
Household broadband data consumption in the United States has also been surging in recent years, in part likely due to the increase in remote activities. According to the OpenVault Broadband Insights (OVBI) report,[13] average monthly broadband data usage of households in the United States at the end of 2021 was 2.6 higher than the 2017 level and grew by 56% compared to Q4 2019 (prior to the pandemic), reaching 536.3 GB Gigabytes (GB) per month (OpenVault, 2022[25]). Both the growth in data consumption

and consumers upgrading their fixed broadband offers reflect an increased demand for higher quality and reliable broadband networks, which will likely only grow over the next decade.

To foster connectivity, regardless of whether the last mile access is fixed or mobile broadband, a key element is deploying fibre deeper into networks to unlock the full potential of emerging technologies, such as the Internet of Things (IoT)[14] and artificial intelligence (AI). Fibre is also required for 5G networks as it connects cell sites through what is called "backbone" and "backhaul" connectivity, also referred to as "middle-mile" infrastructure in the United States.[15] That is, fixed and mobile broadband infrastructure are complementary.

The rate of fixed broadband penetration in the United States stood at 38.3 subscriptions per 100 inhabitants in June 2022, slightly higher than the OECD average of 34.7. However, the use of high-speed fibre networks was lower than the OECD average in the United States, as the share of fibre-to-the-home (FTTH) subscriptions over total fixed broadband reached 19.9%, below the OECD average of 35.9%, and well below leading OECD countries, such as Korea (87.3%), Japan (83.9%), Spain (81.2%), Sweden (79.6%) Lithuania (78.6%) (OECD, 2023[24]). At present, cable is the predominant broadband technology in the United States, while the share of Digital Subscriber Line/Loop (DSL) copper wired connections is declining (Figure 4.1).

Figure 4.1. Evolution of fixed broadband access technologies (United States vs. OECD), 2010-22, by subscriptions per 100 inhabitants



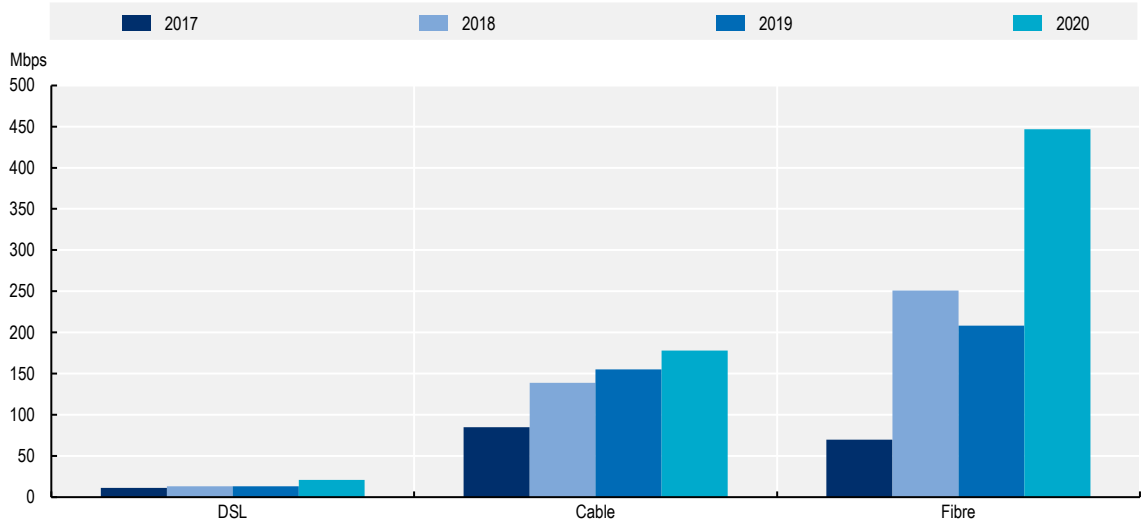
Note: Data for 2022 correspond to June 2022. Fibre subscriptions data includes fibre-to-the-home (FTTH) also known as fibre-to-the-premise (FTTP), and fibre-to-the-building (FTTB); it excludes fibre-to-the-curb (FTTC) and fibre-to-the-node (FTTN). "Other" includes fixed wireless access (FWA), satellite and other technologies.
Source: OECD (2023[24]), *OECD Broadband Portal (database)*, https://www.oecd.org/sti/broadband/broadband-statistics/.

There is a recent push towards more fibre deployment in the United States, likely stemming from an increased demand for higher quality connections. Fibre networks provide symmetrical upload and download speeds, which translates into better support for activities that require upload throughput, such as teleworking or online courses via video conferencing (OECD, 2022[5]). Historic funds are being made available to upgrade and expand broadband networks (see section "A window of opportunity: Broadband infrastructure funding in the United States"). From 2020-21, fibre-to-the-home (FTTH) subscriptions grew by 40.3%, compared to an OECD average growth of 18.6% (OECD, 2023[24]), although they started from a lower baseline level than the OECD average.

Broadband performance is a key element to gauge the state of connectivity. It is often correlated to the type of access technology pervasive in the market. Advertised fixed broadband download speeds have been increasing in the 2017-20 period, with the highest speeds reported by fibre providers (FCC, 2021[26]). Advertised average download speeds in 2020 of copper DSL, cable and fibre fixed ISPs were 20.6 Mbps, 177.9 Mbps and 446.6 Mbps, respectively (Figure 4.2).

Advertised speeds tend to differ from actual speeds experienced by users. According to M-Lab data, the average fixed broadband download speeds experienced in the United States during the period of July 2020 to June 2021 were 92.2 Mbps (M-Lab, 2022[27]). Ookla's measure for fixed broadband speeds (average of peak speeds experienced by users) in June 2021 was 195.5 Mbps in the United States (Ookla, 2021[28]; OECD, 2022[5]). Still, according to both data sources, M-Lab and Ookla, the United States was above the OECD average (i.e. 63.8 Mbps and 136 Mbps, respectively) (OECD, 2022[5]).[16]

Figure 4.2. Advertised fixed broadband download speeds in the United States, by technology



Note: Weighted average advertised download speeds among fixed broadband ISPs. The median speed of each ISP is weighted by the number of subscribers of that ISP as a fraction of the total number of subscribers across all ISPs (FCC, 2021[26]). The y-axis refers to megabit per second (Mbps).
Source: FCC (2021[29]), *Measuring Fixed Broadband - Eleventh Report*, https://www.fcc.gov/reports-research/reports/measuring-broadband-america/measuring-fixed-broadband-eleventh-report.

Mobile broadband deployment seems to be advancing at pace in the United States. Mobile broadband penetration was 171.6 subscriptions per 100 inhabitants in June 2022 (ranked 3rd among OECD countries), compared to an OECD average of 128. Moreover, the United States was one of the first OECD countries to launch 5G commercial services (on 3 April 2019, by Verizon), with the other two mobile carriers launching the same year (i.e. AT&T and T-Mobile). While experienced download speeds in 5G networks in the United States were lower than the OECD average in Q4 2021 (101.7 Mbps vs. 181 Mbps in the OECD area),[17] it was a leading OECD country, after Korea, in terms of 5G availability measured by the percentage of time that the signal is available (i.e. 21.6% vs. an OECD average of 9.1% in Q4 2021) (Opensignal, 2022[30]; OECD, 2022[5]).[18]

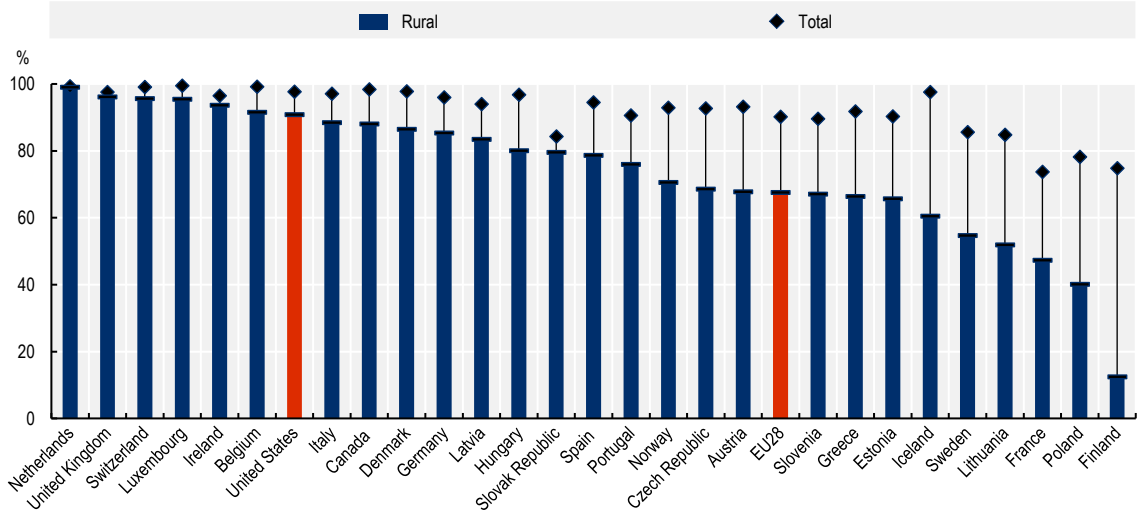
Existing territorial connectivity divides

Being connected *well* means having access to high-quality broadband services at affordable prices. Overall, the main sources of complaints by broadband users in the United States refer to the availability

(36%), billing practices (33%) and speeds of broadband services (13%) (FCC, 2022[31]),[19] which point to issues that may be more acute in rural areas. Users in rural areas often face a lack of broadband coverage, have limited or no choice among ISPs (there is often only one ISP providing broadband in their communities), and typically experience lower broadband speeds compared to their urban counterparts.

High-speed broadband coverage in rural areas remains a major challenge for many OECD countries, including the United States. For example, the availability of fixed broadband services in terms of geographical coverage with a minimum speed of 30 Mbps reveals significant gaps between rural and urban households. In Europe, for example, only 67.5% of rural households were located in areas with coverage of fixed broadband with a minimum speed of 30 Mbps, compared to 90.1% of households in overall areas in 2021. In June 2021, in the United States, the availability of 25 Mbps fixed broadband was 90.7% in rural areas, against 97.6% in total (Figure 4.3).

Figure 4.3. Households in areas where fixed broadband with a contracted speed of 30 Mbps or more is available, 2021

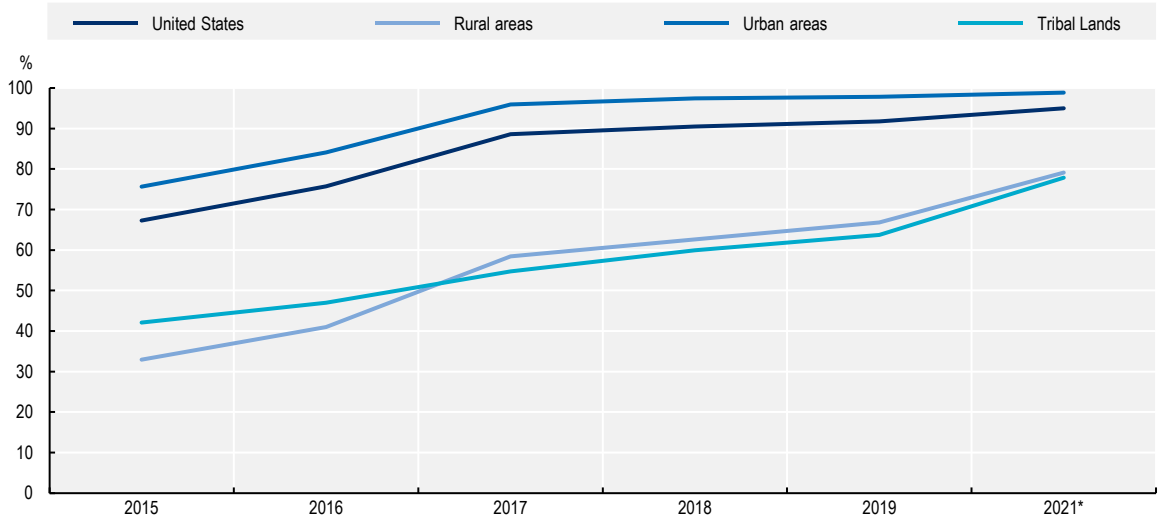


Note: Canada, Iceland, Norway and Switzerland: data are for 2020; the United States: data are for June 2021. *Fixed broadband coverage:* For EU countries, coverage of VDSL, FTTP, and DOCSIS 3.0 capable of delivering at least 30 Mbps download was used; For the United States, coverage of fixed terrestrial broadband capable of delivering 25 Mbps download and 3 Mbps upload services was used (i.e. match the fixed broadband definition used in the European Union, satellite offers are excluded). The United States uses the population coverage approach rather than percentage of households covered. *Rural areas*: For EU countries, rural areas are those with a population density of less than 100 inhabitants per square kilometre. For Canada, rural areas are those with a population density of less than 400 per square kilometre. For the United States, rural areas are those with a population density of less than 1 000 per square mile or 386 people per square kilometre.
Source: OECD calculations based on CRTC (2021[32]), *Communications Monitoring Report 2022*, https://crtc.gc.ca/eng/publications/reports/PolicyMonitoring/ban.htm; EC (2022[33]), *EU Digital Scoreboard - Data Visualisation Tool*, European Commission; FCC (2021[15]), *Fourteenth Broadband Deployment Report*, https://www.fcc.gov/reports-research/reports/broadband-progress-reports/fourteenth-broadband-deployment-report; FCC (2023[34]), *Area Summary: Fixed Broadband Deployment Data (map dataset)*, https://broadbandmap.fcc.gov/#/area-summary?version=dec2020&type=county&geoid=39029&tech=acfosw&speed=100_10&vlat=40.80890148289103&vlon=-80.75536588457368&vzoom=10.226932829218589.

Looking at the different areas of the United States, there are persistent gaps in fixed broadband coverage at 100 Mbps download speeds (and 10 Mbps upload) among urban, rural, and Tribal Land areas. According to the FCC's Fourteenth Broadband Deployment report and the latest public data from the FCC (June 2021), 79.1% and 77.9% of the population in rural areas and Tribal Lands in 2021, respectively, lived in areas where fixed broadband offers at these speeds were available, which compares to 98.9% of the population living in urban areas (Figure 4.4) (FCC, 2021[15]; 2023[34]).[20] These figures relate to broadband

deployment measured by the reported coverage of ISPs to the FCC, and thus may underestimate the actual coverage gap (see more on the FCC's current efforts to improve broadband mapping in section on the importance of granular data on broadband availability and quality).[21] Moreover, the urban-rural-Tribal connectivity divide in terms of adoption, measured by the amount of individuals and households actually connected, tends to be more pronounced. According to the FCC's 2020 "Communications Marketplace Report", the overall adoption rate of 100 Mbps broadband in 2019 was 50.9% at the national level, 50% in rural areas, and 36.2% on Tribal Lands (FCC, 2020[35]). Moreover, according to the NTIA's Internet Use Survey, 73.3% of urban households had fixed high-speed Internet service at home in 2021, which compares to 58.7% of rural households (NTIA, 2022[36]).

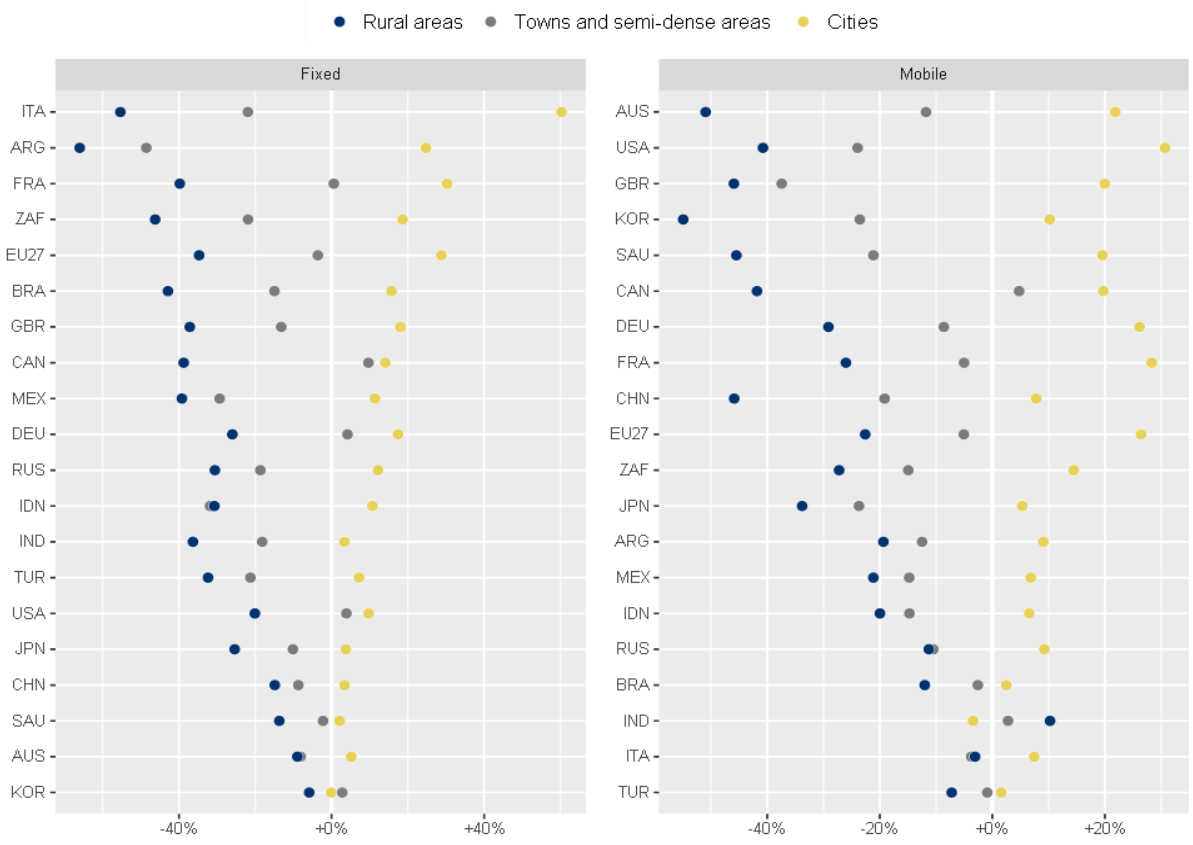
Figure 4.4. Fixed broadband (100 Mbps) population coverage in the United States, by area



Note: The FCC designates a census block group as rural (or Tribal land) if more than 50% of the population in the census block group resides in census blocks designated as rural (or Tribal land). The definition of fixed broadband includes satellite providers.
* Data for 2021 refers to June 2021 using the latest public release of the FCC's form 477 data.
Source: FCC (2021[15]), *Fourteenth Broadband Deployment Report*, https://www.fcc.gov/reports-research/reports/broadband-progress-reports/fourteenth-broadband-deployment-report, Appendix H: Deployment (Millions) of Fixed Services (includes Satellite) at Different Speed Tiers in the United States (31 December 2019); data for June 2021 from FCC (2023[34]), *Area Summary: Fixed Broadband Deployment Data (map dataset)*, https://broadbandmap.fcc.gov/#/area-summary?version=dec2020&type=county&geoid=39029&tech.

Territorial differences in connectivity also translate into user experiences that vary substantially depending on where people live and work, as evidenced by the differences in actual download speeds in cities compared to rural areas (OECD, 2021[4]). For the G20, data from self-administered connection speed tests by Ookla for G20 countries show that download speeds over fixed networks in rural areas were on average 31 percentage points below the national average in the last quarter of 2020. Download speeds in cities, on the other hand, were on average 21 percentage points above the national average (OECD, 2021[4]). By comparison, in the United States, this territorial difference was less pronounced with rural areas exhibiting speeds on average 20 percentage points below the national average, and cities being situated at roughly 10 percentage points above the national average. Disparities in mobile download speeds were similar to those in fixed broadband speeds across G20 countries, with a 52-percentage point difference on average between rural areas and cities (OECD, 2021[4]). The United States, however, had more significant territorial differences, exhibiting an important 72-percentage point gap and the second highest among G20 countries (Figure 4.5).

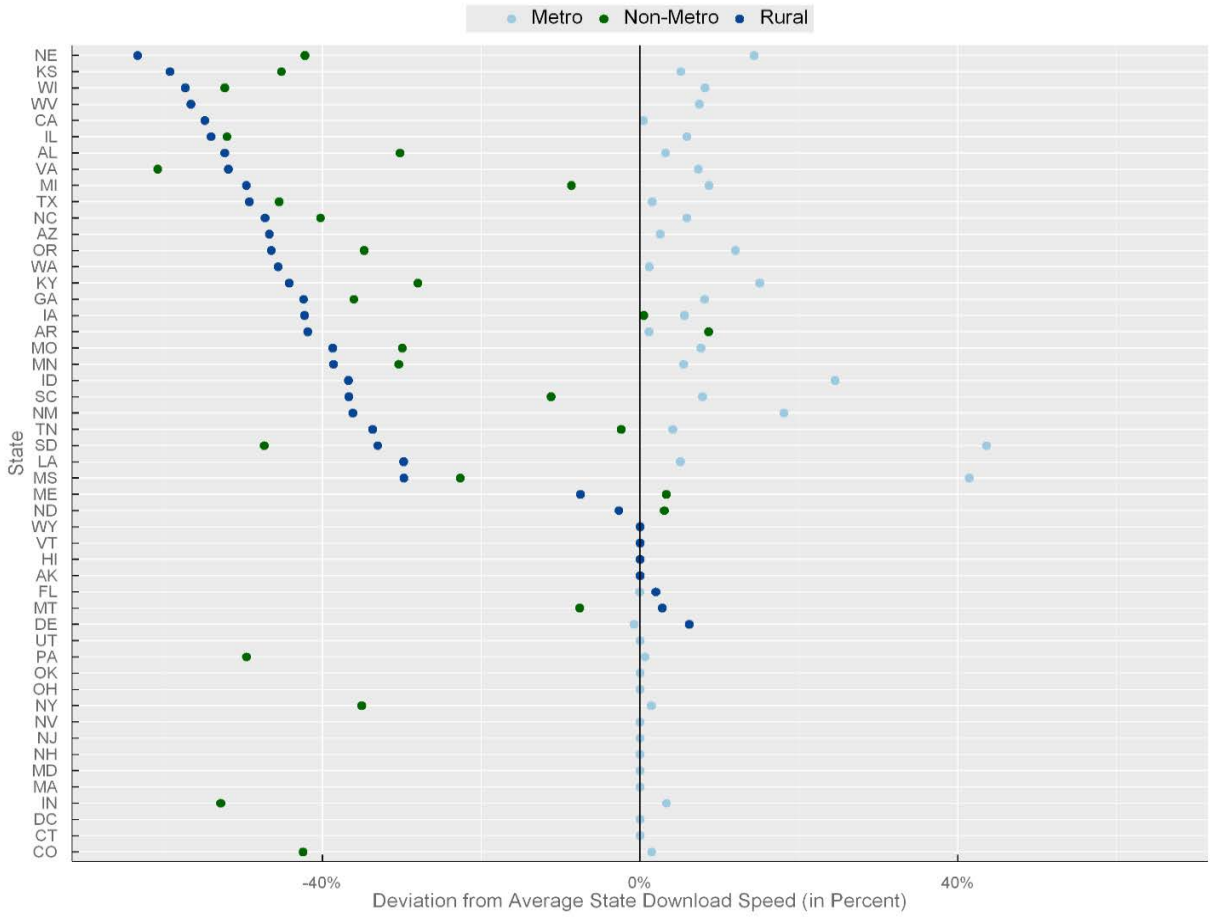
Figure 4.5. Gaps estimated as percentage deviation from national averages (Q4 2020) in G20 countries, by degree of urbanisation



Note: Speedtest data corresponds to Q4 2020. The data for average fixed and mobile broadband download Speedtests reported by Ookla measures the sustained peak throughput achieved by users of the network. Measurements are based on self-administered tests by users, carried over iOS and mobile devices. Aggregation according to the degree of urbanisation was based on GHS Settlement Model (GHS-SMOD) layer grids. The figure presents average peak speed tests, weighted by the number of tests.
Source: OECD calculations based on Speedtest® by Ookla® Global Fixed and Mobile Network Performance Maps. Based on analysis by Ookla of Speedtest Intelligence® data for 2020Q4. Provided by Ookla and accessed 27 January 2021. Ookla trademarks used under license and reprinted with permission.

Using the same source (Ookla), data across the 50 states in the United States shows a clear regional divide in terms of the quality of mobile broadband experienced, as evidenced by the large gaps between urban (metro) and rural areas measured by the mean deviation from the state average in 4G 2020 (Figure 4.6).[22] In the first quarter of 2021, there was a 51-percentage point gap in download broadband speeds experienced by users between urban (metro) and rural regions across states. In Nebraska, South Dakota and Mississippi, the gap was greater than 70 percentage-points. On the other hand, the level of download speeds in these three states was 80.5 Mbps, 88.3 Mbps and 54 Mbps, respectively. According to Ookla data, the level of download speeds in states varied widely, from 42.6 Mbps (Wyoming) to 132.6 Mbps (Utah) in Q1 2021.

Figure 4.6. Gaps in download speeds experienced by users in states of the United States, by TL3 (small region) classification, estimated as a percentage deviation from state averages, Q1 2021



Note: Ookla dataset with a TL3 (small regions) classification (see *OECD Regional database* http://dx.doi.org/10.1787/region-data-en).[23] Within small regions, the OECD has three main classifications: "Metropolitan regions", "Regions near a metropolitan area" and "Regions far from a metropolitan area". Within the last category, two further sub-categories are included: "Regions close to small/medium city" and "remote regions". Metro = "Metropolitan region", a region where at least half of its population lives in a metropolitan area (i.e. a functional urban area of at least 250 000 inhabitants). Non-metro = "Non-metropolitan region with access to small/medium city", a region where 50% of its population lives within a 60-minute drive of a small- or medium-sized city (functional urban areas with a population of less than 250 000 inhabitants and above 50 000). Rural = "Non-metropolitan remote region", a region with less than 50% of its population living within a 60-minute drive of a functional urban area. *Honolulu, Hawaii (HI) is the only small region (TL3) in the dataset classified as rural. Therefore, the "state" average of Hawaii corresponds to the rural area average (Honolulu). For Alaska (AK), a similar case is Anchorage, which is the only TL3 region and is classified as rural. This is a similar issue as concerns the states of Vermont and Wyoming. An additional caveat is that in several US states and the District of Columbia (DC) the dataset presents missing data (NA) for rural regions, when in part, this is because the OECD classification is too aggregated to show territorial diversity in some states including: Colorado (CO), Connecticut (CT), Indiana (IN), Massachusetts (MA), Maryland (MD), New Hampshire (NH), New Jersey (NJ), Nevada (NV), New York (NY), Ohio (OH), Oklahoma (OK), Pennsylvania (PA) and Utah (UT).
Source: OECD calculations based on Speedtest® by Ookla® Global Fixed and Mobile Network Performance Maps data for Q1 2021. Provided by Ookla and accessed 7 July 2022. Ookla trademarks used under license and reprinted with permission.

Bridging connectivity divides in the United States

In light of the broadband coverage and quality gaps across territories, action is needed to ensure ubiquitous, affordable, and high-quality connectivity in the United States. *Affordability* and *high-quality* broadband services usually derive from competition in communication markets and investment in networks.

Overarching policies that foster competition, promote investment and ease infrastructure deployment are important tools to spur the expansion of high-quality communication networks, including in rural and remote areas that are often underserved or completely unserved (OECD, 2021[4]). Indeed, the United States recognises the importance of boosting competition and reducing barriers to deployment to bridge digital divides as part of the Telecommunications Act of 1996 (United States Congress, 1996[37]). These policies also reduce the need for public investments to areas where business cases are not likely to be viable, and where alternative approaches (e.g. through public-private partnership or public funding) might be required.

Combining market forces with alternative approaches is key to expand connectivity (OECD, 2021[4]). As such, the regulatory, legal and institutional framework plays a fundamental role to bridge connectivity divides, in particular for the communication sector that is characterised by high fixed costs and barriers to entry. However, a thorough assessment of the regulatory, legal and institutional framework in the United States with an analysis of the level of competition in communication markets, is beyond the scope of this report on rural innovation. It would require a dedicated country review on Telecommunication Policy and Regulation.[24] Therefore, this section will provide a brief overview of broadband availability in rural areas, as well as good practices taken in OECD countries to promote broadband deployment that could inspire policies and actions in the United States.

Promoting competition and incentives to invest in broadband networks

Experience in OECD countries such as Mexico (OECD, 2017[38])[25] has shown that promoting competition is one of the strongest levers to extend connectivity and increase affordability and quality of communication services, including to underserved populations. Competitive communication markets influence not only investments, but also the affordability of communication services, which is a major obstacle for broadband adoption in the United States.[26]

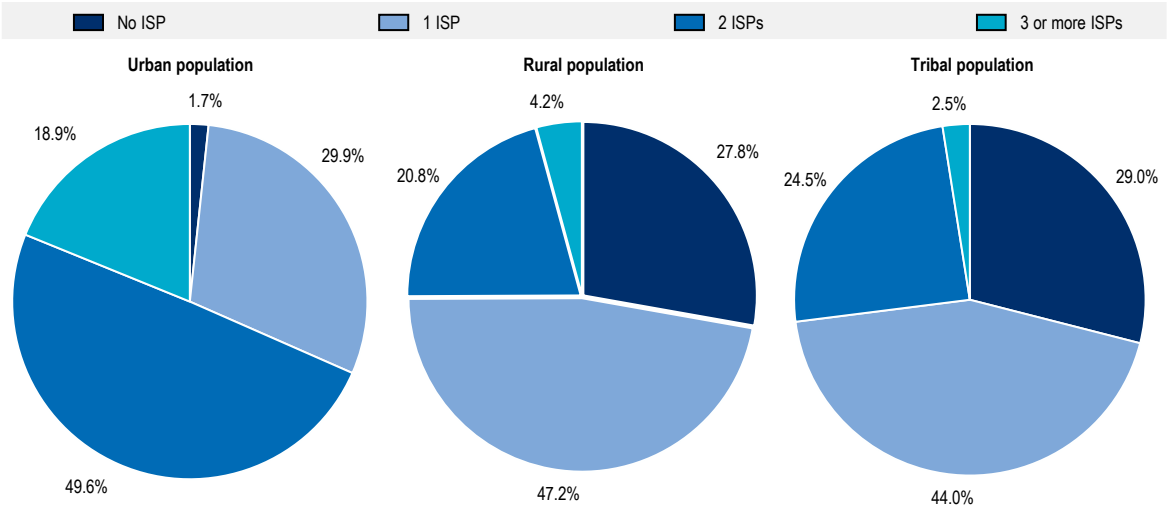
In terms of communication market participants, the mobile market in the United States has four Mobile Network Operators (MNOs). In April 2020, T- Mobile acquired Sprint, bringing down the total of MNOs in the country from four to three. However, the United States imposed remedies on the T- Mobile/Sprint merger as a way to keep the market open for a fourth player (OECD, 2021[39]). The main condition imposed by the Department of Justice (DoJ) was for T-Mobile to divest a substantial amount of assets to a company called Dish, so that it could become the fourth wireless carrier (DoJ, 2020[40]). Under commitments to the FCC, Dish needed to reach 20% of the population in the United States with 5G by June 2022 and 70% by June 2023. The company reached the first milestone on 14 June 2022 (Dish, 2022[41]).

There are seemingly many fixed-wired broadband providers (2 627) in the United States according to BroadbandNow data that relies on FCC's reporting form 477 (BroadbandNow, 2022[42]). However, when taking a regional look (TL3 level), on average, there are only four ISPs by small region in the United States, which means that many consumers may find themselves with limited choice of providers. In rural areas, it may be only one DSL copper or satellite broadband provider, and in some instances, no provider at all.

Considering the availability of broadband offers by speed tiers at 100 Mbps download and 10 Mbps upload speeds, people living in rural areas and on Tribal Lands are either not covered at all by any ISP, or only have one ISP offering such services (Figure 4.7). The availability of such offers is important to ensure high-quality connectivity for all. As part of the Notice of Inquiry that starts the FCC's annual evaluation of the state of broadband across the country, a new baseline broadband definition of 100 Mbps download and 20 Mbps upload speeds was proposed in July 2022 (FCC, 2022[43]).

To illustrate the lack of provider choice at county level, Table 4.1 shows the percentage of the population living in rural areas where 100 Mbps download speed broadband offers are available in the respective counties of the three communities visited for the field research of this project: Gallup, Pine Bluff and Columbiana.

Figure 4.7. Percentage of the population living in areas with 100 Mbps download speed fixed broadband offers, by number of providers



Note: Data are for June 2021 (latest public release of form 477). The definition of fixed broadband includes satellite providers.
Source: FCC (2023[34]), *Area Summary: Fixed Broadband Deployment Data (map dataset)*, https://broadbandmap.fcc.gov/#/area-summary?version=dec2020&type=nation&geoid=0&tech=acfosw&speed=100_10.

Table 4.1. Percentage of the population living in rural areas with 100 Mbps download speed fixed broadband offers, by number of providers, in three counties of the United States

	No providers (ISPs)	1 provider	2 providers	3 or more providers
McKinley County (Gallup, New Mexico)	80.1	17.6	2.22	0
Jefferson County (Pine Bluff, Arkansas)	85.4	13.5	1.13	0
Columbiana County (Columbiana, Ohio)	18.7	63.4	16.7	1.2

Note: Data are for June 2021 (latest public release of form 477). The definition of fixed broadband includes satellite providers.
Source: FCC (2023[34]), *Area Summary: Fixed Broadband Deployment Data (map dataset)*, https://broadbandmap.fcc.gov/#/area-summary?version=dec2020&type=nation&geoid=0&tech=acfosw&speed=100_10.

With the aim of fostering fibre deployment, communication regulators across the OECD are both looking to foster competition while incentivising investments in networks. OECD countries may opt to use pro-competitive wholesale access regulation to promote both retail-based and infrastructure-based competition. Some do it through wholesale fibre access remedies applied only to the dominant operator with geographical segmentation considerations (Spain and Portugal); others apply similar measures to all operators, but regulation depends on the geographical area, such as in France (OECD, 2022[5]). For example, Spain has emerged as a connectivity leader in Europe, using a combination of wholesale access regulation that spurs competition and targeted public funds (Box 4.2). In the United States, there are wholesale access regulatory measures imposed on the historical fixed broadband incumbent (e.g. copper unbundling requirements and some unbundling requirements in terms of wholesale fibre).

Box 4.2. Spain: Pro-competitive wholesale regulation and targeted public funds

In recent years, Spain has emerged as a fibre connectivity leader in Europe, with the country's regulatory environment a key driver of private sector-led investment in fibre networks. Two regulatory measures have been key. First, third party network access obligations on the formerly state-owned incumbent, Telefonica, were capped at 30 Mbps, meaning that new entrants could use Telefonica's network to deliver connectivity only up to those speeds, with Telefonica obligated to sell wholesale access at regulated pricing. Secondly, Telefonica was obligated to allow new entrants to use their ducts to build their own networks.

In 2016, after seven years of the initial phase of regulatory forbearance for fibre deployments, Spain applied fibre wholesale access regulation based on geographical segmentation of competitive versus non-competitive areas (Godlovitch et al., 2019[44]). In 2021, the Spanish communication regulator relaxed the imposed obligations by deeming more geographical areas of the country "competitive markets". The result of these measures has been a rapid rollout of "Fibre-to-the-home" (FTTH) connectivity across the country, with fibre as a percentage of total fixed broadband connections growing from 35% in 2016 to 81.2% in June 2022 (ranked 3rd in the OECD after Korea and Japan, see the OECD Broadband Portal).

Public funding outside urban areas complements the supportive regulatory environment. Backed by funding from the European Regional Development Fund, Spain has delivered major programmes to subsidise connectivity investment in rural areas, and in 2021, to expand the next evolution of broadband networks to the whole country:

- Next Generation Broadband Expansion Programme (NGBEP) (2013-20). This programme intended to support private investment, with the aim of extending the deployment of high-speed broadband networks (more than 100 Mbps) to the most remote areas.
- The 300x100 Project. Subsequent to the NGBEP, this project aims for even faster connections, targeting connectivity of at least 300 Mbps to 100% of households nationwide. Up to EUR 525 million (USD 620.6 million)[27] are being distributed to fund projects in rural areas.
- Recovery, Transformation and Resilience Plan (2021-26). In 2021, connectivity and 5G have been identified as the key pillars for Spain's economic recovery plans (OECD, 2022[5]). Spain allocated EUR 4.3 billion (USD 5.08 billion)[28] of the European Recovery Funds (Next Generation EU) to expand 5G networks during the period 2020- 2025 (La Moncloa, 2021[45]).

Source: Based on OECD (2021[4]), *Bridging Digital Divides in G20 Countries*, https://doi.org/10.1787/35c1d850-en; OECD (2022[5]), "Broadband networks of the future", https://doi.org/10.1787/755e2d0c-en; Government of Spain (n.d.[46]), *Outreach Programme of Broadband of New Generation (PEBA-NGA) in the Period 2019-2021*, https://avancedigital.mineco.gob.es/en-us/Participacion/Paginas/Cerradas/PEBA-NGA-2019-2021.aspx; Godlovitch, I. et al. (2019[44]), *Prospective Competition and Deregulation: An Analysis of European Approaches to Regulating Full Fibre for BT*, https://www.ofcom.org.uk/__data/assets/pdf_file/0020/145046/b-group-wik-report-annex.pdf; La Moncloa (2021[45]), ""Recovery Plan is most ambitious economic plan in Spain's recent history", says Pedro Sánchez", https://www.lamoncloa.gob.es/lang/en/presidente/news/Paginas/2021/20210413recovery-plan.aspx.

The importance of granular data on broadband availability and quality

Improving the accuracy of broadband data at a granular level is crucial to ensure end-user transparency and increase the effectiveness of broadband policy measures. Broadband maps, for example, can influence the allocation of funds to close connectivity gaps in unserved and underserved areas, such as the case of broadband funds of the Infrastructure Investment and Jobs Act in the United States.

The FCC's efforts to upgrade broadband mapping are commendable. The United States Congress passed the Broadband Deployment Accuracy and Technological Availability (DATA) Act in 2020 instructing the FCC to improve its broadband maps. The FCC launched in February 2021 a "Broadband Data Task Force" with the aim to "lead a cross-agency effort to collect detailed data and develop more precise maps about broadband availability" (FCC, 2021[47]). The Head of the FCC reported on the progress of the Task Force's for over 18 months at the end of June 2022, stating that they had opened their system to collect data from over 2 500 broadband providers (FCC, 2022[48]). In November 2022, the FCC released a pre-production draft of its new National Broadband Map, where the public will be able to submit challenges to improve its accuracy (FCC, 2022[49]).

With the aim of improving transparency for end users, several communication regulators across the OECD, including the United States, are using innovative approaches, such as "crowd-sourcing" techniques and volunteer tests with whiteboxes to measure the quality and coverage of broadband networks (OECD, 2022[5]). In 2011, the FCC set up a voluntary quality of service (QoS) measurement programme in collaboration with SamKnows, called "Measuring Broadband America" (FCC, 2021[26]).

OECD countries also increasingly make use of government sponsored tools to draw broadband comparisons in terms of both availability and prices, given that affordability is a key concern for consumers. The United States government could consider adding a price dimension to broadband mapping efforts. Consumers need clear, transparent, and readily accessible information on communication services to make informed decisions, and any comprehensive list of broadband metrics developed by policy makers and regulators should therefore include indicators on prices. Access to this information empowers consumers, provides useful insights about the level of competition in the market, and complements other metrics used to assess the sector's overall efficiency and performance (OECD, 2013[50]). The OECD has developed a new methodology for bundled communication price baskets, which could be helpful (OECD, 2020[51]).

Easing infrastructure deployment as key element to boost investment in networks

The role of local governments to ease broadband network deployment

Local governments have a key role to play to foster broadband deployment. One important barrier to broadband infrastructure deployment is the lengthy administrative processes to obtain "rights of way".[29] Administrative procedures often require approval from several different public authorities at different levels of government. In rural communities with different land property rights, as seen in the example of Gallup, New Mexico (Box 4.1), the issue is even more acute.

The United States, through the FCC, has carried out efforts to streamline access to rights of way, through the 2018 order "Accelerating Wireless and Wireline Broadband Deployment by Removing Barriers to Infrastructure Investment." The FCC decision determines the amount that municipalities may reasonably charge for small cell deployment given the practicalities and importance of 5G deployment. In offering guidelines for determining this value, the FCC cited the rules of 20 states that limit upfront pole fees to USD 500 for use of an existing pole, USD 1 000 for installation of a new pole, and recurring fees of USD 270 per year (OECD, 2019[52]). However, this effort has faced hurdles in some municipalities as this may increase the burden already placed on local governments.

Access to rights of way is an issue present in many OECD countries and can be aggravated depending on the level of autonomy of municipalities, which in some countries, is protected at the Constitutional level (e.g. Sweden). This requires a high degree of collaboration between national, state/regional and local authorities. In Sweden, for example, collaboration to ease broadband deployment is undertaken through the Broadband Forum, which brings together all three levels of government (OECD, 2018[53]). Some OECD countries issue a code of "Good Practices" in an effort to streamline access to rights of way, and others monitor how municipalities adhere to the national communication law (e.g. Spain). Colombia publishes an

index of municipalities measuring the degree that capital cities "ease infrastructure deployment" to provide incentives for municipal authorities to reduce barriers for network rollout (CRC, 2022[54]; OECD, 2022[55]).

To further ease infrastructure deployment, the United States could also build on existing efforts to reduce the administrative burden and costs associated with broadband deployment at the local level. Enhancing the collaboration among national, state, and local authorities, for example through a task force established by the National Telecommunications and Information Administration (NTIA) and the FCC that includes representatives from local and state authorities, could help in this regard. The latter could leverage existing programmes by the NTIA, such as the State Broadband Leaders Network (SBLN), to streamline access to rights of way. The SBLN is a network of practitioners working on state broadband initiatives and provides a platform to strengthen collaboration among states, local authorities, and federal agencies (NTIA, n.d.[56]).

Making information available for operators to increase deployment efficiency

Increased access to information and public assets also plays a crucial role in broadband deployment since it is time-consuming to determine where to build towers and then buy or lease that property. To ease this process, the United States could consider increasing transparency and access to information of public assets, as other countries have done.

For example, in Mexico, the National Telecommunication Infrastructure Information system (*Sistema Nacional de Información de Infraestructura*, SNII), approved and issued by the Mexican communication regulator (*Instituto Federal de Telecomunicaciones*, IFT), includes useful information on rights of way geared at allowing licensed communications to deploy communication infrastructure on public assets, such as buildings. This inventory reveals the availability and status of public infrastructure that can be leased by operators with the aim to increase efficiency in deploying communication networks, reduce deployment costs, and increase broadband coverage (Gonzalez-Fanfalone et al., 2021[57]).

With respect to broadband deployment, several OECD countries have an "infrastructure atlas" available for communication service providers, that allows them to access information on the specific location of backbone and backhaul connectivity as well as other types of wholesale infrastructure (OECD, 2022[5]). This enhances transparency for infrastructure-sharing and joint-deployment initiatives that bring deployment costs down. While not all countries have this data available online, France launched in 2017 a map where consumers, providers and general stakeholders can consult fibre infrastructure, both at retail and wholesale level (https://cartefibre.arcep.fr/). The United States could assess the costs and benefits of making available such wholesale infrastructure information available to market players.

Promoting efficient spectrum management to bridge connectivity divides

Spectrum is a scarce essential input, in the form of invisible airwaves, that is required to provide mobile broadband connectivity, among other wireless services. Spectrum management has a role in the efforts to close connectivity gaps though mobile connectivity, for example, by imposing build-out requirements in licences or by allowing access to unused spectrum to expand connectivity in underserved areas. Increasingly, several OECD countries view an individual's right to communication services as being just as important as the right to electricity or fresh water. They consider this right a prerequisite for digital transformation (OECD, 2022[58]).

Coverage obligations in spectrum assignment procedures, such as auctions, along with a competitive communication market, have proven to be an effective tool in OECD countries to extend mobile broadband coverage in rural and remote areas (OECD, 2022[58]). For example, Brazil deemed extending broadband coverage as the most important policy objective in the 5G auction that concluded in November 2021, as opposed to focusing only on revenue maximisation. The award process included coverage obligations (for the 700 MHz band) in federal highways and investment commitments to increase mobile broadband coverage and fibre backhaul in Brazilian municipalities (Anatel, 2022[59]; OECD, 2022[58]).

The United States is continually making efforts to promote the efficient use of spectrum and granting access to various entities in the market (OECD, 2022[58]). For example, the 2.5 GHz band was licensed to non-profit schools for educational purposes, and in 2020, the FCC established a "Tribe Priority Window" to allow Tribes in rural areas to directly access unassigned 2.5 GHz spectrum to expand broadband in their lands (FCC, 2021[60]). Moreover, to increase the participation of a designated subset of entities in spectrum auctions, the United States routinely offers bidding credits to small firms or providers in Tribal Lands, which lowers their final payments by a pre-established amount (FCC, 2022[61]). The United States is also promoting spectrum sharing and flexible use licences. More details can be found in the OECD report "Developments in Spectrum Management for Communication Services" (OECD, 2022[58]).

Community networks and local ISPs connecting rural areas

Municipal networks are used in several OECD countries to promote fibre deployment in cities, smaller towns, and surrounding regions. These networks are typically high-speed networks that have been fully or partially facilitated, built, operated, or financed by local governments, public bodies, utilities, organisations, or co-operatives that have some type of public involvement (OECD, 2015[62]).

Recent OECD work looked at two examples of municipal networks in the United States: Chattanooga, Tennessee and Lafayette, Louisiana (OECD, 2022[5]). Chattanooga provides an example of a successful municipal network provided by the Electric Power Board (EPB), which is currently offering advertised speeds of up to 10 Gbps. LUSfiber in Louisiana is a similar case of a municipal network, which has been a utility provider for 120 years. After winning a Supreme Court case in 2009, LUSfiber was able to operate as an ISP in Lafayette, Louisiana (Talbot, Hessekiel and Kehl, 2018[63]). Like EPB in Chattanooga, LUSfiber is offering advertised speeds up to 10 Gbps (BroadbandNow, 2021[64]).

In addition to municipal networks, community networks are often bottom-up approaches in rural and remote areas that build on local knowledge and initiatives, and can play a complementary role with respect to national service providers in bridging connectivity divides (APC, 2020[65]). Institutional framework conditions may be key to fostering bottom-up initiatives that seek to expand connectivity in rural and/or remote areas. For example, in Mexico, the rise of community networks in rural areas has been facilitated by changes ushered in by the 2013 telecommunication reform, whereby social use spectrum licences include community and indigenous networks with non-profit purposes (OECD, 2017[38]). In Brazil, the communication regulator (Anatel) explicitly recognised community networks as an option for Internet access in Brazil (Anatel, 2020[66]).

Spectrum licensing can be used as a tool to promote wireless local community broadband networks. The spectrum licensing framework in several OECD countries allows to cater to local networks to address rural connectivity needs, including with low-cost licences to extend coverage in rural and remote areas (e.g. Australia, Finland, Japan, Mexico, New Zealand, Sweden, the United Kingdom and the United States) (OECD, 2022[58]). In Mexico, social purpose spectrum licences can be used to provide not-for-profit communication services, such as mobile broadband. To date, five social purpose licenses have been granted for the provision of communication services in Mexico. In addition, 467 commercial licences (i.e. for-profit) have been granted through Wireless Internet Service Providers (WISPs), which provide broadband services mainly in rural areas (OECD, 2022[58]).

Deployment costs of fibre are much higher in sparsely populated areas than in urban ones. As such, in commercially "unattractive" areas, community networks can help lower fibre deployment costs given their knowledge of local conditions. For example, apart from the municipal fibre network, the institutional framework also encourages local communities to form co-operatives to roll out fibre networks, commonly referred to as "village networks". The "village fibre" approach is based on the premise of community involvement to plan, build and operate local fibre networks in co-operation with municipalities and commercial operators. Compared to commercial broadband projects, village fibre projects can achieve cost savings of some 50% using an innovative handling of permissions as well as excavation and voluntary

work. A further reduction of some 25% is achieved through public funds (state aid), making the connection fee equivalent to that of urban areas (OECD, 2018[53]). In the United States, an example of a successful rural fibre co-operative network is the Dakota Carrier Network (Box 4.3).

Box 4.3. Dakota Carrier Network

North Dakota in the United States is a highly rural and sparsely populated state with a density of just 4.1 persons per square kilometre. Out of the 50 states and territories, North Dakota ranks 49th in population density. Despite this, 76.6% of rural residents in North Dakota have access to Gigabit speed connectivity (i.e. more than 1 000 Mbps download with 100 Mbps upload speeds), a level that far exceeded the national average in both rural (19%) and urban (29.3%) areas (as of December 2020) (FCC, 2020[67]).

North Dakota's success in bridging rural connectivity divides is largely the result of a consortium of small, independent rural companies and co-operatives that came together in 1996 to purchase the 68 rural exchanges from the incumbent telephone company. In doing so, these small organisations formed the Dakota Carrier Network (DCN), a state-wide umbrella organisation that covers 90% of the state's land area and 85% of its population (Sousa and Herman, 2012[68]). The development of the DCN's fibre network received USD 10.8 million in federal funding support through the Broadband Technology Opportunities Programme. The DCN also enhanced e-health in the state by deploying a dedicated 10 Gbps health care network to over 200 hospitals, clinics, and other health care providers to enable telemedicine, tele-radiology, tele-pharmacy, and electronic health information exchange (NTIA[69]).

Source: Adapted and updated from OECD (2021[4]), *Bridging Digital Divides in G20 Countries*, https://doi.org/10.1787/35c1d850-en; FCC (2020[67]), *Compare Broadband Availability in Different Areas*, https://broadbandmap.fcc.gov/#/area-comparison?version=jun2019&tech=acfosw&speed=25_3&searchtype=county; Sousa, J. and R. Herman (2012[68]), *A Co-operative Dilemma: Converting Organizational Form*, http://base.socioeco.org/docs/co-operative_dilemma.pdf; NTIA (n.d.[69]), *BroadbandUSA - North Dakota*, https://www2.ntia.doc.gov/north-dakota.

Municipal and community broadband networks add to the gamut of solutions to bridge rural connectivity divides in the United States. However, there are still hurdles for local networks in the United States, as 17 states have legal restrictions that render it difficult for (or ban) local governments wishing to offer broadband services if there are commercial providers already present in the market (BroadbandNow, 2021[70]). Efforts to promote an enabling environment for these local networks to flourish could help bridge divides in rural and remote areas. These conditions range from reconsidering outright legal bans in certain states, to promoting access and interconnection to 'middle mile' fibre backhaul and backbone connectivity, as well as some degree of regulatory forbearance (e.g. with respect to reporting obligations).

Towards "digital equity": Fostering broadband adoption among disadvantaged groups

Digital divides can vary in terms of geography (e.g. as urban and rural areas), by gender, by age, by skill level, by firm size, and in general, by different vulnerable groups in society. Some aspects of digital divides are, of course, common to most geographical areas such as income disparities or lack of skills. Other aspects of the digital divide are accentuated by differences in geography. The definition of "gap" or "divide" inherently means a comparison; therefore, there is an implicit reference group in mind when assessing them (e.g. rural versus urban areas, small and medium enterprises [SMEs] versus large firms, developed versus emerging economies, etc.) (OECD, 2021[71]).

The United States is keen to understand the main actions to take to bridge divides and enhance affordability. For example, in February 2022, the FCC launched a cross-agency effort to "combat digital discrimination", i.e. to promote equal access to broadband across the country regardless of where people live, their income level, ethnicity, race, religion, or national origin (FCC, 2022[72]).

Affordability, a key obstacle for broadband adoption by disadvantaged groups

Affordability is one of the main barriers to broadband uptake by households and business in many OECD countries, including the United States, leading to accentuated digital divides. Affordability can relate to both the cost of broadband service as well as the cost of the terminal device to access the service (e.g. tablet, computer, or smartphone), and this can disproportionally affect low-income households and/or populations living in rural areas. In the United States, 26% of people in households with incomes under USD 25 000 per year had no Internet service subscription at all, which compares to only 9% of adults in high-income households (i.e. annual income above USD 100 000) lacking any type of Internet service (NTIA, 2022[36]; NTIA, 2022[73]).

In addition to overarching policies that increase competition and investment in broadband markets explored in previous sections that influence the affordability of communication services, some OECD countries have also established assistance and subsidised service programmes targeted to low-income populations (i.e. demand side initiatives) to promote uptake of broadband services. In the United States, the FCC's Affordable Connectivity Program provides qualifying households with a discount of up to USD 30 per month to afford broadband access, and up to USD 75 per month for eligible households in Tribal Lands (FCC, 2022[74]).

As a complementary measure to policies promoting the rollout of residential and business broadband connections, some countries are also implementing public broadband access solutions (e.g. in the form of public Wi-Fi hotspots). For example, in Colombia, the project *Acceso Universal para Zonas Rurales - Centros Digitales* ("Project for Universal Access to Rural Areas - Digital Centers") aims to provide public Wi-Fi connectivity solutions in 14 750 "Digital Centers" throughout all Colombian departments until 2031 (OECD, 2022[55]). However, these hotspots can never substitute for household and business broadband subscriptions, and, in addition, the government faces the challenge of continuing to fund such programmes indefinitely.

Countries may also implement tailored measures to bridge the rural digital divide, such as specific public funding to complement private investment to deploy broadband networks in rural areas. For example, the Government of Canada, through the Investing in Canada Plan launched in 2016, committed over USD 143.5 billion (CAD 180 billion)[30] over 12 years for infrastructure projects, including to increase broadband connectivity in rural and northern areas of the country (Government of Canada, 2018[75]). New Zealand has established the Rural Broadband Initiative (Phase II) and the Mobile Black Spot Fund that are delivering improved broadband and mobile services to inhabitants in rural and remote areas. Over USD 304 million (NZD 430 million)[31] in grant funding from the Telecommunications Development Levy has been allocated for the Rural Broadband Initiative in New Zealand to provide improved broadband to target around 10 000 rural households and businesses (Government of New Zealand, 2018[76]).

Digital literacy and its role in bridging digital divides

Digital literacy is the set of knowledge, skills, and behaviours that enable people to understand and use digital systems, tools and applications, and to process digital information. These capabilities and aptitudes link with a population's capacity to be innovative, productive, and creative, and to participate in democracy and the digital economy (OECD, 2018[3]).

In the United States, the National Telecommunications and Information Administration (NTIA) has implemented programmes, such as the Sustainable Broadband Adoption programme, to support training activities in rural areas to show the relevance of broadband-based services to rural non-adopters and to encourage people to invest time in digital skills training (OECD, 2018[3]). More recently, within the funding allocated to boost broadband deployment and adoption under the auspices of the Infrastructure Investment and Jobs Act (IIJA), the NTIA is administering the Digital Equity Act, which allocates USD 2.75 billion to promote digital inclusion, including the promotion of digital skills and digital literacy (NTIA, 2022[77]).

In Colombia, government-led initiatives have fostered the training of community champions to promote the locally based efforts to provide face-to-face assistance to individuals who need help acquiring digital skills (OECD, 2018[3]). In Canada, beyond government-led programmes, private initiatives are also seeking to advance digital literacy in remote areas. Pinnguaq, a not-for-profit technology start-up founded in 2012 in Nunavut, a vast but sparsely populated territory in northern Canada, is helping remote indigenous communities to learn computer and coding skills (Pinnguaq, n.d.[78]).

Connecting small and medium firms

Persistent digital divides across firm size may translate into a large share of firms not having the same access to opportunities that the digital transformation has to offer, which may result in productivity gaps. Therefore, policy makers try to ensure that all businesses, regardless of their size, can benefit from the digital transformation. In the United States, bridging connectivity divides among small and medium-sized enterprises (SMEs) is particularly relevant and 99.4% were small businesses in 2020 (United States Census Bureau, 2020[79]).[32]

Some OECD countries have tailored policies or conducted research on the level of connectivity of specific user groups considered to be lagging, such as SMEs. In the United Kingdom, the communication regulator, Ofcom, carried out quantitative and qualitative research to understand the experiences and attitudes of the market for communication services for SMEs. The research found that SMEs often have Internet services that are not optimal for their business, namely with reference to bandwidth, affordability, upload speeds or use in peak times (Ofcom, 2018[80]).

In France, connecting SMEs with fibre networks has been a priority for the communication regulator Arcep since 2016 (Arcep, 2018[81]). To promote competition and innovation regarding the provision of broadband services, the French regulator has opted to experiment. It put in place a “regulatory sandbox”, which primarily consisted of a limited regulatory waiver of up to two years for start-ups wishing to test new technologies or offer an innovative service. Arcep has also established dedicated office hours within the largest French incubator space, “Station F”, to inform start-ups on issues related to spectrum or numbering, for example.

A window of opportunity: Broadband infrastructure funding in the United States

At present, the United States is witnessing a historic inflow of public funds to expand and upgrade broadband infrastructure. This is a unique window of opportunity to bridge connectivity divides by fostering “future-proof” deployments. It may also enhance the choice of broadband providers across the United States, which, in turn, influences affordability conditions. The way these funds will be implemented may help change the connectivity landscape in the United States in the coming decades.

The main source of public funds is the Infrastructure Investment and Jobs Act (IIJA), signed into law in November 2021, which allocates USD 65 billion to expand broadband. Four agencies are leading the efforts of the IIJA: the Department of Commerce's NTIA, the FCC, the Department of the Treasury, and the USDA.

The NTIA will manage around USD 48 billion in the context of the IIJA through four programmes to expand access, affordability and adoption of high-quality broadband services (i.e. the Broadband Equity, Access and Deployment Program [i.e. BEAD] the Digital Equity Act Programs, the Tribal Connectivity Technical Amendments, and the Enabling Middle Mile Infrastructure programme). Out of the four programmes, the largest is the BEAD programme, which provides USD 42.45 billion to be distributed among states, territories, the District of Columbia and Puerto Rico, for projects that support broadband infrastructure deployment and adoption (NTIA, 2022[82]). The NTIA launched in May 2022 an initiative called "Internet for all", grouping three out of the four initiatives of the IIJA managed by them (i.e. the BEAD programme, the Digital Equity Act, and the Middle Mile Infrastructure programme), together with other existing programmes (NTIA, 2022[83]). All states and territories confirmed their participation, in adherence with the deadlines, by July 2022 (NTIA, 2022[84]).

The NTIA's newly established Office of Internet Connectivity and Growth is in charge of administering the BEAD funds. Through the BEAD programme, states will receive federal grants for projects to build out broadband access for "unserved" and "underserved" areas where broadband connections exhibit speeds lower than 100 Mbps (NTIA, 2022[82]). The NTIA published on 13 May 2022 the Notice of Funding Opportunity (NOFO) for the BEAD programme, which established rules on how to allocate the funds at state level. The NOFO mentions a preference for fibre deployment, makes a distinction between unserved and underserved areas with funding available for both, and includes notions of open access and affordability. In addition, while funding is available for all access technologies, the BEAD rules mention that areas currently covered only by satellite broadband or service based on unlicensed spectrum will be considered unserved (NTIA, 2022[85]). BEAD funding will depend on the availability (and approval) of the new broadband coverage maps from the FCC.

It is praiseworthy that the BEAD rules (NTIA's NOFO of May 2022) include the notion of open access to lower barriers of entry to local markets and promote competition at the retail level. In addition, signalling a preference for fibre is a welcome development given that it is a scalable "future proof" technology allowing for symmetrical speeds, which are increasingly important in a remote economy and may also be more energy efficient than other access technologies (OECD, 2022[5]). At the moment of writing, the way states would implement the BEAD rules was still being determined. An important question will be the implementation of notions of affordability, open access obligations and preferences for the deployment of future-proof access technologies, such as fibre, found in the NTIA's NOFO. The success in the implementation of BEAD funding by states will also depend on the level of engagement with rural communities.

Apart from the BEAD programme, the NTIA will also administer USD 1 billion in funding to enable "middle mile" broadband infrastructure, such as undersea cables and IXPs, to connect access networks (NTIA, 2022[82]). In addition, the Digital Equity Act allocates USD 2.75 billion to promote digital inclusion (e.g. promoting Internet adoption, development of digital equity plans, promotion of digital skills and digital literacy), and the Tribal Connectivity Technical Amendments (USD 2 billion), which is a programme to help expand high-speed broadband to Tribal Lands. The latter complements the existing Tribal Broadband Connectivity Program.[33]

In addition to IIJA funds administered by the NTIA, the FCC will manage USD 14.2 billion for the Affordable Connectivity Program, and the USDA will administer USD 2 billion for the Rural Utilities Service programme. The IIJA also includes Private Activity Bonds (amounting to USD 0.6 billion) authorising state and local governments to use private activity bonds for rural broadband deployment (NTIA, 2022[86]).

Funds managed by the USDA will also play a role in bridging rural connectivity gaps. To that end, the IIJA provides USD 2 billion for USDA broadband programmes, including USD 1.926 billion for the ReConnect programme that offers loans and grants to help ISPs cover underserved areas of the country, as well as USD 74 million for Rural Broadband Program loans. It also directs USD 5 million of the technical assistance funds to establish and support rural community networks ("rural telecommunications cooperatives") to offer

broadband service in rural areas. The IIJA calls on the USDA to collaborate with the FCC and NTIA in awarding funding for broadband projects (CRS, 2021[87]). The USDA has made two rounds of IIJA funding for ReConnect projects available, where historically underserved communities are exempted from matching the grant funding (USDA, n.d.[88]).[34] Moreover, the Consolidated Appropriations Act of 2023 allocates USD 363.5 million for USDA's ReConnect programme that offers loans and grants to help ISPs cover underserved areas of the country. It also allocates USD 35 million for USDA's Community Connect Grant Program to help eligible applicants to provide broadband services in rural, economically-challenged communities. This adds to the budget allocated to the USDA within the IIJA.

In 2021, as part of the recovery package of the COVID-19 pandemic, the American Rescue Plan Act (ARPA) of 2021 allocated USD 7.17 billion, out of USD 1.9 trillion, for broadband connectivity and infrastructure funding (i.e. the Emergency Connectivity Fund [ECF]) administered by the FCC. Moreover, on 25 February 2021, the FCC adopted a Report and Order (R&O) that established the Emergency Broadband Benefit Program, a USD 3.2 billion federal initiative to help lower the cost of high-speed Internet for eligible households during the COVID- 19 pandemic. The Emergency Broadband Benefit Program was developed by Congress in the Consolidated Appropriations Act of 2021 (FCC, 2021[89]). Other eligible funds to invest in broadband access by states include the Coronavirus State and Local Fiscal Recovery Funds (SLFRF) programme, part of the ARPA in 2021, which allocated USD 350 billion to state, local, and Tribal governments to support their response and recovery from the COVID-19 pandemic. The Consolidated Appropriations Act of 2023 provides additional flexibility for these entities to spend their SLFRF (ARPA) allocations. For instance, the Act allows entities to spend their allocations as part of the matching funds requirement for BEAD projects (i.e. at least 25% of grant matching by states).

In terms of promoting affordability of broadband services, the United States Government says it is engaging with ISPs to ensure low-cost Internet offers (e.g. USD 30 per month or less) to boost adoption among low-income households (NTIA, 2022[86]). However, a crucial question is how this will be implemented. If the initiative relies on voluntary and non-binding actions by ISPs, it remains to be seen whether service providers would offer low-cost options with sufficiently high speeds. A second option is to tie the requirement of affordable offers to new public grant conditions. For example, the BEAD rules (NOFO) contain requirements of affordability. However, how this notion is implemented will likely depend on the states receiving the funding. The third option would be for the FCC to impose *ex-ante* rate regulation on broadband providers, for example, if they received any public funding. However, it is unclear whether the FCC could pursue that route within the existing legal framework.[35]

The use of market mechanisms, such as competitive tenders and reverse auctions, is a common tool used across the OECD to allocate scarce public funds to meet policy objectives in geographical areas that are underserved by broadband networks (e.g. Italy, Korea, the United Kingdom and the United States). The Rural Digital Opportunity Fund (RDOF) is an existing measure to bridge connectivity divides in rural and remote areas in the United States. Launched in 2020, the FCC will fund up to USD 20.4 billion over 10 years to finance high-speed broadband networks ("up to Gigabit speeds") in rural and remote areas. The funds will be awarded through a two-phase reverse auction mechanism favouring players both willing to provide faster download speeds and willing to accept the lowest grant money per customer. Phase I of the project, where the auction concluded on 25 November 2020, granted USD 9.23 billion in funding targeting over six million homes and businesses in census blocks completely unserved by voice and broadband with speeds of at least 25 Mbps (i.e. 5 220 833 locations in 49 states and one territory) (FCC, 2022[90]). In the past, concerning the RDOF decision, the then-Commissioner and now head of the FCC, underscored the importance of accurate broadband mapping and increasing the baseline definition of broadband speeds.[36]

Apart from the importance of granular data to allocate funds, reverse auctions that consist of broadband coverage "promises" at certain speeds and low deployment cost require a thorough understanding of the bidder's financial ability to sustain such deployment promises. On July 2022, the FCC proposed fines amounting to USD 4.3 million to the companies defaulting on their RDOF obligations by failing to comply with the deployment deadlines. The FCC estimates that the defaults prevented investments in broadband infrastructure in 129 909 locations across 36 states (FCC, 2022[91]).

Another source of funding available for broadband development projects relates to universal service provisions, under the FCC's remit. In the past, these funds were pivotal for the National Broadband Plan of 2009. One of the main pillars of the Communications Act of 1934 (United States Congress, 1934[92]), the sectoral legislation in the United States, amended in 1996, was to foster the universal service of communication services "at just, reasonable and affordable rates". The Telecommunications Act of 1996 expanded the traditional goal of universal service to include Internet services (United States Congress, 1996[37]). As such, communication providers, including ISPs, contribute to the Universal Service Fund (USF). The USF targets four main projects: 1) the Connect America fund to support connectivity in rural areas, 2) the "Lifeline" programme to support low-income consumers including residents of Tribal Lands, 3) the E-Rate programme to support the connectivity of schools and libraries connectivity, and 4) the rural health care programme (FCC, 2022[93]).

In addition to the above, the FCC and the NTIA also manage programmes to ensure connectivity of educational institutions. The Emergency Connectivity Fund mainly aims to connect schools, libraries, and eligible consortia by supporting the purchase of tablets, hotspots, and routers, and/or broadband access (FCC, 2022[94]). According to the FCC, total commitments up to July 2022 (USD 5.6 billion over 3 application windows) have funded over 11 million connected devices and more than 7 million broadband connections, helping 12.8 million students through the support of around 10 000 schools, 900 libraries, and 100 consortia. The FCC committed additional funding to these 3 ECF windows (USD 266 million) to connect schools and libraries on 13 July 2022 (FCC, 2022[95]). The NTIA is promoting broadband connectivity of colleges and universities serving minority populations. In July 2022, the NTIA awarded 5 grants (amounting to USD 10 million) to expand high speed broadband in Historically Black Colleges and Universities (HBCUs), Tribal Colleges and Universities (TCUs), Hispanic Serving Institutions (HSIs), and Minority-Serving Institutions (MSIs) (NTIA, 2022[96]).

Given the plethora of existing and programmes and grants to boost broadband connectivity and bridge rural digital divides, there is an opportunity to leverage synergies of ongoing programmes undertaken by the FCC, such as the RDOF and universal service provisions, with existing IIJA grants. Moreover, to ensure the success of such initiatives, collaboration across agencies and at all levels of government, with an emphasis on local engagement, continues to be key.

Enabling Human Capital Assets for Innovation: Education

A second key framework condition for innovation in rural counties of the United States is access to education. While the role of education is critical in providing equal opportunities, the quality and delivery of educational services is often more limited in rural regions. High costs and resource limitations make it particularly challenging to provide education to all people (OECD/EC-JRC, 2021[2]). Because of the decentralised nature of administering education services, and its partial dependency on local taxes, the quality of education is often uneven.

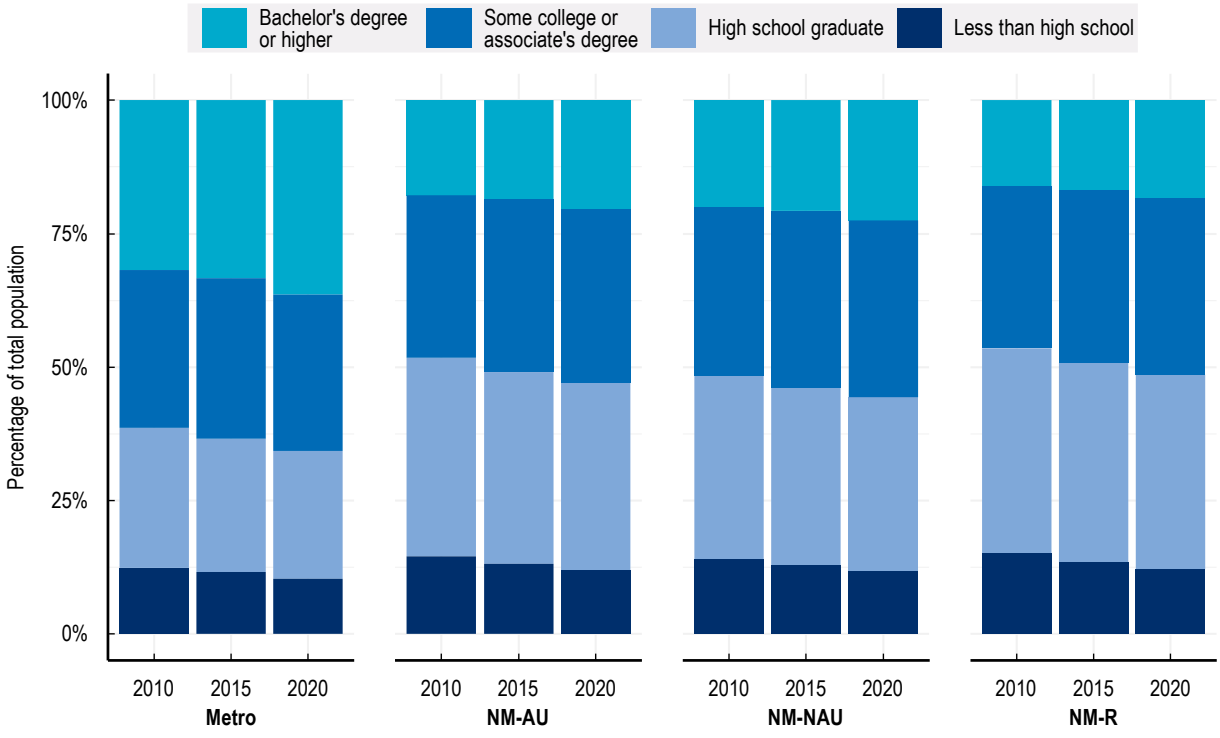
Non-metropolitan counties tend to have lower shares of individuals with at least a bachelor's degree (Figure 4.8). The share of highly educated workers, which is often associated with innovation, differs in metropolitan and non-metropolitan regions (see Chapter 2). In non-metropolitan regions, higher shares of some college[37] or associate degrees are positively correlated with increased productivities, suggesting that quality college and associate's education may be relatively more relevant for non-metropolitan regions.

On the other hand, the shares of population with different levels of education are similar across the three types of non-metropolitan counties.

Over time, we have observed a steady rise in shares of those educated with at least a bachelor's degree across all regions and a steady decline of those with less than high-school education. However, the largest share of individuals in non-metropolitan areas are those with high school graduate degrees and this remains relatively constant over time, as Figure 4.8 shows.

Education is more expensive in non-metropolitan counties. The increased costs of delivery are often associated with greater distances for teachers and school staff as well as infrastructure (OECD/EC-JRC, 2021[2]). As Figure 4.9 shows, the percentage of government spending on education per capita is concentrated in local government. When local government tax bases are low because of the low population density characteristics of rural and non-metropolitan regions, this can aggravate the challenge.

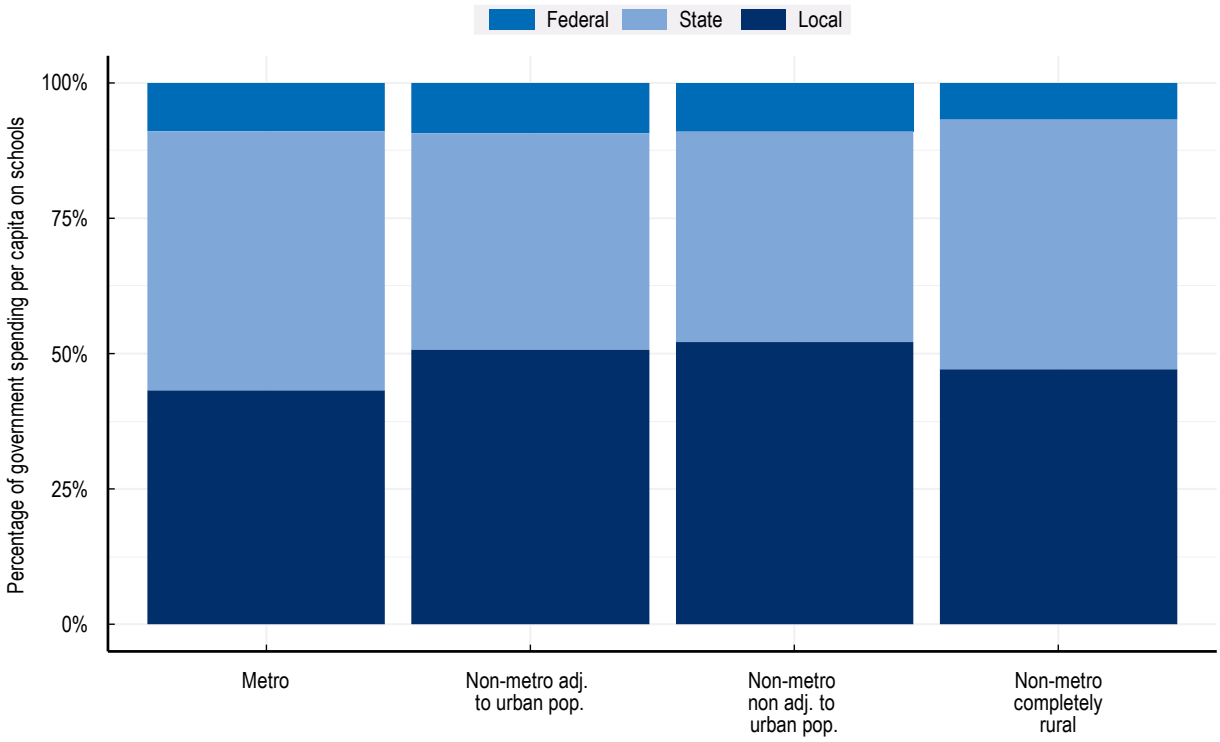
Figure 4.8. Educational attainment by type of county, 2010, 2015, 2020



Note: Categories in this figure are described in Chapter 2, and based on the USDA's Rural-Urban Continuum Codes (RUCC). "Metro" refers to metropolitan counties. "NM-AU refers to non-metropolitan counties adjacent to urban populations. "NM-NAU" refers to non-metropolitan counties that are not adjacent to urban populations. "NM-R" refers to rural non-metropolitan counties.
Source: U.S. Census Bureau (2022[97]). *American Community Survey Data.* https://www.census.gov/programs-surveys/acs/data.html.

Figure 4.9. Government spending on education

Educational spending by type and geographical classification, 2017



Note: Spending on education statistics, refer to government (public) spending are from 2017, the last year available. Geographical classifications refer to groupings elaborated in chapter 2, and based on the USDA's Rural-Urban Continuum Codes (RUCC). "Metro" refers to metropolitan counties. "Non-metro adj. to urban pop." refers to non-metropolitan counties adjacent to urban populations. "Non-metro non-adj. to urban pop." refers to non-metropolitan counties that are not adjacent to urban populations. "Non-metro completely rural" refers to rural non-metropolitan counties.

Source: National Center for Education Statistics. (2022[98]) *Administrative Data Collections at NCES*. https://nces.ed.gov/admindata/. [accessed: January 15, 2022].

Setting the scene on access to education

The communities that form the basis of this study, Pine Bluff (Arkansas), Columbiana (Ohio) and Gallup (New Mexico), are in different stages of a community revitalisation effort. As part of this process, the local leadership is working to make them more attractive for new businesses, help existing businesses to innovate, and encourage entrepreneurship. Identifying effective mechanisms to support innovation in rural regions is challenging in itself. When this is undertaken as part of a wider community revitalisation effort to help deepen and diversify the local economy and transform it into something more sustainable, it adds a layer of complexity for all involved.

The case study regions have some commonalities and stark differences. Each of the regions have experienced the ebb and flow of growth and decline, limited population growth, areas of disinvestment, and/or a depressed economy. Many of the difficulties these rural areas faced stemmed in part from the loss of an industry or businesses. Of course, small and struggling does not need to be the only narrative. The 2018 *Micropolitan Success Stories from the Heartland*, a report by the Walton Family Foundation, provides a look at several small communities that have been able to rebuild, grow and transform their local economies (Ross DeVol, 2018[99]). The report concluded that "small-town America has big-time potential for economic growth" and recognised the ability to "boost the nation's economy" and "bridge the economic

gaps" between the urban and rural areas (Ross DeVol, 2018[99]). In addition, it identified a variety of players (e.g., universities and research institutions; community colleges and workforce development; and entrepreneurial awareness support) as key contributing factors to the economic turnaround in the small rural towns studied (see Box 4.4). In the case study communities, we have noticed the following:

- Pine Bluff is a rural town that retained a strong sense of community. However, it has a challenged and underperforming K-12 education infrastructure that impacts the ability of local residents to take full advantage of the strong two-year community college and four-year university in the region. This reality complicates a key priority for Pine Bluff leaders of building the capacity of local residents to own businesses and become entrepreneurs.
- In Columbiana, investment in the town centre and the Main Street Theatre was done to build community as well as drive economic growth, attract new businesses, and create new jobs. Columbiana's public high school includes a class that provides students with an opportunity to work with industry leaders. Despite good initiatives such as "pop-up shops" and a virtual storefront tool,[38] new businesses in the community could benefit from more training mechanism and streamlined resources to develop "new" entrants. These are potential entrepreneurs with limited resources and no intergenerational family business background or experience.
- Gallup is an economic hub in western New Mexico surrounded by a patchwork of land belonging to the Navajo Nation and private individuals. Rather than simply seeking to attract major employers, the city is trying to take advantage of its key assets, namely its transportation routes, to build new economic opportunities (Williams, Howe and Grey, 2021[100]). While Gallup has a 2-year college and 4-year university that offer great opportunities, there was a notable disconnect between local market needs and the training and skills available. The disconnect is such that private sector leaders have stepped in to support the development of a vocational curriculum that matched industry needs to fill the skills gap.

Enhancing human capital to strengthen education, skills and training is important in revitalising communities. Indeed, it was clearly a priority for community leaders in the case study regions. Evolving industry objectives and business needs require school systems to be highly responsive to new patterns of demand and adapt their provision accordingly. To enable local firms to find employees locally and innovate, it is vital that the education infrastructure, K-12, higher education and vocational and training systems, work together.

This section focuses on a few lessons learned from the discussions in the region. The first section looks at the K-12 education system that is providing the necessary foundation for transition to higher education or employment. The second section focuses on the role of higher education in fostering innovation locally. Finally, the third section looks at the ecosystem of education, workforce training and industry, and the fourth addresses entrepreneurial skill building and the capacity of the local population to take advantage of new opportunities and grow their businesses or engage in start-ups.

Box 4.4. Seven Key Attributes That Can Help Spur Economic Growth in Small Towns

In *Micropolitan Success Stories from the Heartland* the authors measured the performance of 531 small towns in the United States. Based on this list, Pecos, Texas, with a population of approximately 12 000, ranked first. The metric for all 531 areas defined as "micropolitans", included a young-firm employment ratio ranking (from 2016); per-capita personal income ranking (from 2016); 5-year job growth ranking; 1-year job growth; 5-year average annual income growth; 1-year pay growth; and 5-year personal income growth.

Seven key attributes contributing to their strong economic growth:

1. Universities and Research Institutions.
2. Community Colleges and Workforce Development.
3. Entrepreneurial Awareness, Support, and Access to Early-Stage Risk Capital.
4. Diversified and Thoughtful Strategic Economic Development Planning.
5. Manufacturing, Logistics/Supply Chain, and Foreign Direct Investment.
6. Technology, Professional, Scientific and Technical Services.
7. Quality of Place.

Source: Ross DeVol, S. (2018[99]), *Micropolitan Success Stories from the Heartland*, https://8ce82b94a8c4fdc3ea6d-b1d233e3bc3cb10858bea65ff05e18f2.ssl.cf2.rackcdn.com/d7/f9/00e59918410b83b3a3471533dd44/micropolitan-success-stories-report-print-updated-5.11.2018.pdf.

Strengthening the elementary and secondary education infrastructure

The main goal of any education system should be that all children and young people achieve their full learning potential. In the United States, 57% of school districts and 32% of public schools are rural, and they educate about 12 million (24%) students (NCES, 2013[101]). Family and personal characteristics are often an additional challenge for rural school systems, especially those in persistently poor and low-education areas (Gibbs, 2005[102]). The National Center for Education Statistics found that 19% of rural students in remote areas attended high-poverty schools, as did 11% in distant rural areas and 8% in fringe rural areas (NCES, 2013[101]).

Table 4.2. Education related statistics from Gallup, NM, Pine Bluff, AR, and Columbiana, OH

	Gallup, New Mexico	Pine Bluff, Arkansas	Columbiana, Ohio
Race and ethnicity:			
White	31.5%	19.0%	95.0%
Black or African American	1.4%	76.0%	2.4%
American Indian	47.7%	0.3%	0.3%
Citizens 33 and younger			
Graduate high school	84.1%	86.2%	84%
Bachelor's degree or higher	20.1%	19.6%	14.5%
Median age	30.2	34.3	51.6
Persons above 65 years	13.3	15.2	31.1%
Persons under 18 years	31.2%	22.8%	17.6%
Reading proficiency	22%, 44%, 49%	12%	86%
Math proficiency	4%, 9%, 26%	8%	64%
College Readiness Index	7.9 – 9.6/100	9.7/100	14.7/100
Persons in poverty	33.7%	25.4%	12.5%

Note: Gallup has 3 public district high schools.
Source: U.S. Census Bureau ([103]), *QuickFacts: Columbiana County, Ohio; Pine Bluff City, Arkansas; Gallup City, New Mexico*, https://www.census.gov/quickfacts/fact/table/columbianacountyohio,pinebluffcityarkansas,gallupcitynewmexico/PST120221; U.S. News & World Report (n.d.[104]), *Columbiana High School*, https://www.usnews.com/education/best-high-schools/ohio/districts/columbiana-exempted-village/columbiana-high-school-15378; U.S. News & World Report (n.d.[105]), *University of Arkansas Pine Bluff Rankings*, https://www.usnews.com/best-colleges/university-of-arkansas-pine-bluff-1086/overall-rankings; U.S. News & World Report (n.d.[106]), *High Schools in Gallup-Mckinley Cty Schools District*, https://www.usnews.com/education/best-high-schools/new-mexico/districts/gallup-mckinley-cty-schools-109891.

Rural students often deal with a lack of access to quality reading materials and instruction at an early age (especially preschool), a lack of consistent access to medical care, and other factors (Bailey, 2021[107]). Some call for more "rural-conscious policies" and more careful attention to the specific needs of rural educators, students, and families (David Arsen, 2021[108]). Teacher shortages, student mental health, broadband access, and school funding are all areas of deep concern. Preparing local youth for success with a high-quality public school district is an important component to building a skilled workforce. Localities should pursue a development strategy that incorporates improvements in education.

Basic education is a foundation that inspires young people to stay in school, to train to acquire skills for the labour market, or, for some, to pursue higher education. According to figures from the U.S. News & World Report, in the Pine Bluff School District, only 12% of the high school students tested at or above the proficient level for reading, and 8% tested at or above that level for math (U.S. News & World Report[109]). The Pine Bluff State Board of Education has noted that the district had produced a significant imbalance of students with insufficient skillsets, limiting their ability to contribute to the local economy and workforce (Matheson, 2022[110]). In Gallup, a look at the three public high schools in the district revealed subpar math proficiency levels of 4%, 9% and 26% and reading at 22%, 44% and 49% respectively (U.S. News & World Report[106]).

Teacher recruitment and certification in rural communities is a struggle for school and district leaders. Schools with more experienced teachers tend to have better results in the Programme for International Student Assessment (PISA) science test and a better school climate. However, often the education system in rural communities falls short. The Pine Bluff State Board of Education has noted that students could go through the Pine Bluff K-12 system without interacting with a certified teacher (Matheson, 2022[110]). Nonetheless, teacher characteristics are significantly associated with better performance (OECD, 2011[111]). An underperforming K-12 education system can have a lasting negative impact on the local labour market and make it more difficult for students to transition to higher education or to join the workforce. Supporting education that drives innovation means helping people in rural communities to explore how existing resources related to the education and skills infrastructure may be strengthened and utilised in more effective and productive ways.

Higher education and innovation

Higher education institutions play a key role in promoting innovation. Universities and colleges are well placed to build and develop new initiatives through strategies that improve workforce development, knowledge generation and dissemination. The very nature of innovation leads to demands for diverse skills, which underscores the importance of developing and maintaining links with universities.

Nonetheless, fostering innovation is not a straightforward task for universities, particularly in rural regions, where more context-sensitive studies are required (Salomaa, Charles and Bosworth, 2022[112]). Programmes that were considered relatively successful for rural populations in the United States, such as Land Grant Colleges, are often overlooked (Lyons, Miller and Mann, 2018[113]; Maloney and Valencia Caicedo, 2022[114]). The context-specific approach is even more important as these rural institutions navigate questions over their relevance and calls for mergers or closure (Koricich, 2021[115]).

The attributes to be innovators or entrepreneurs are not endowed at birth. This knowledge is developed over time and, in large part, through education (OECD/EU, 2018[116]). Specifically, innovators need education that increases their ability to effectively use their knowledge and skills with new technologies, products, markets, and business environments. This is where higher education institutions can play an important role as part of a regional innovation support ecosystem.

Given the demographic challenges faced by rural regions, co-ordination between different education institutions is crucial for the establishment of critical mass and the identification of regional strengths. In the education sector, the collaboration between public authorities and the private sector can result in

curricular reforms or changes in teaching practices (OECD, 2016[117]). In regions with low levels of educational attainment, the presence of multiple institutions with well-coordinated transfer routes and accreditation allows students of all types to learn or be retrained. The University of Arkansas Pine Bluff (UAPB) is ranked fourth in top Public Schools and 33 out of 125 in Regional Colleges South (U.S. News & World Reports[105]). UAPB is the second-oldest public university and the only public historically black institution in Arkansas. It offers an exceptional diversity of programmes. Discussions with UAPB revealed that a large majority of its students were not from the Pine Bluff area. Further, graduates of the university tend to leave the region so there is limited long-term economic benefit to the community.

Universities that are in or serve rural communities have to support local communities to find solutions to local problems. The university is the knowledge provider and source of training tailored to respond to new job opportunities and new industries in the region (Salomaa, Charles and Bosworth, 2022[112]). Rural public education institutions, notably, must have attributes that contribute to such overarching objectives (McClure et al.[118]). They include the following:

1. sustain local economies and fuel community development.
2. provide college-educated workers for high-demand local industries.
3. provide an access point for educational opportunity in rural communities.
4. are underfunded, relative to other public colleges.
5. need financial support to serve their communities.

This requires higher institutions to not just be at the table as local economic development strategies are developed. They also need the ability to act in tandem with local economic development leaders to design training and technical skills curriculum for short-term changes in the labour market. For example, most of the EDA's University Centers play a role in working with local economic development leaders (see Chapter 3). In addition, they should be able to anticipate the skills that will be needed within industries in the long term. For example, consultations with industry representatives and staying current on local labour market needs can contribute to the elaboration of training offers that reflect the structure of regional labour markets (OECD, 2018[119]).

Connect the ecosystem of education, workforce, training and industry

Skill shortages are one of the most important obstacles to innovation in a wide range of industries and countries (Cammeraat, Samek and Squicciarini, 2021[120]). A workforce with the right mix of skills and education is an important asset for attracting new industries. Gallup, through the work of the Northwest New Mexico Council of Governments and its partners, has a number of initiatives in the pipeline. These include infrastructure (rail lines; interstate and highways; airports; and broadband fibre); shovel-ready industrial parks (green or brownfield); and water lines (including the Navajo-Gallup Water Supply Project). These projects are designed to galvanize the local economy and increase employment opportunities, among other objectives. However, discussion in the regions highlighted the need for more diverse training options for the local workforce that encourage and enable them to remain in the local community (Jansen, 1988[121]).

The OECD Skills Strategy series has consistently shown that acquiring new skills has the power to transform lives and drive economies. Vocational Education and Training is a natural complement to research and graduate degree programs. Changing labour market needs have created pressures for vocational education and training and other sectors to adapt their educational offer (OECD, 2018[119]) Vocational training is different from other training forms, as it aims to equip students with practical skills and is associated with practical labour use.

A particularly important role is played by the “open access” principle of most two-year community colleges, which allows anyone to enrol in programs. In addition, “developmental” (remedial) education can be a stepping stone for the high proportion of entrants that lack such skills – typically maths and literacy skills (Kuczera and Field, 2013[122]). In Pine Bluff, Southeast Arkansas College (SEARK) provides comprehensive community college education and services, with an emphasis on technical education and workforce development. The college also collaborates with the UAPB to provide workforce training for the existing workforce and to provide basic skills and specialised training for the unemployed. Training addresses the depreciation of human and social capital that can occur during unemployment, as well as the lack of business experience (OECD/EC, 2021[123]). It also plays a key role in reducing dropout rates while facilitating the school-to-work transition.

The needs of local firms, in terms of skills and education levels, can be quite diverse. This was visible in Columbiana. For a small city, Columbiana has a diverse group of industries from pattern making, fabrication, stamping facilities, small foundries, polymer extrusion plants, machine shops and powder coating shops, and even welding shops. Many employers require a high school degree; some were willing to train on the job. Understanding the education and skill levels of the local workforce and the skills that potential growth industries need would lead to strategies tailored to different industries. Skills have an impact on the ability of local firms to compete and to exploit the opportunities represented by innovation. This can be more challenging in rural environments where rural high school graduates are less likely than counterparts in urban and suburban areas to go to college. Moreover, training programmes offered by rural institutions of higher education do not tend to be in sync with the needs of local firms.

The challenge of matching local skills current and anticipated demand to the offer of classes for skills development is commonly observed and addressed through a multi-dimensional approach. In some cases, these are addressed through tripartite consultations (between employers, workers and government institutions, including universities) in what are sometimes referred to as skills councils (OECD, 2016[124]) and in other examples, such as in the Netherlands, through regional cooperation between municipalities (OECD, 2023[125]). In rural areas, such councils may be less feasible because of lack of agglomeration and large universities, however municipal cooperation and tripartite consultations could provide a solution. For example, in the province of Québec had similar challenges of matching local skills demands from employers with local labour supply. In Québec, community colleges (CEGEPs) and their technology transfer centres (CCTTs) were created to combine applied research with industry support and workforce training. They way they address this challenge is by a.) incorporating the objective of service rural communities into the overarching objectives of rural higher education institutions, b.) working with local companies within the region to provide training based on skills needed for innovation and c.) creating a system of incentives, including financial and career promotion, for researchers to innovate with rural companies and communities. Higher education universities such as the University of Quebec at Rimouski are especially designed to connect with territories and the university incentive system for researchers is tied to how well they serve needs of local (and in some cases rural) communities (OECD, forthcoming[126]) .

The provision of vocational education must meet labour market needs, which requires a diversity of offerings and pathways (OECD, 2018[127]). In Pine Bluff, the K-12 system is handicapped by the fact that high school students are not graduating with proficiency. Discussions with SEARK revealed that they offer a wide range of vocational training and skills enrichment courses. For example, at the College Workforce Development Center, students have the opportunity to train or retrain to learn or improve skills, obtain career advancement, transition to a new industry, or train to get industry-based certifications. However, the students from Pine Bluff tend to spend a large portion of their time at the College in remedial courses to catch up on math and literacy skills; hence, they are less able to take advantage of these opportunities.

Box 4.5. Center for Career and Technical Education, Gallup, NM

The Center for Career and Technical Education (CCTE) represents a co-operative effort among the Gallup McKinley County Public Schools, Rehoboth Christian School, Zuni Public School District, Wingate High School and UNM-Gallup to offer career and technical education courses that the individual high schools do not offer.

High School juniors and seniors who wish to enrol in courses at the CCTE should see their counsellors. Those selected to attend will be bused to the CCTE for classes in the morning or afternoon, depending on their schedule and CCTE programme of study selection.

Not only can students earn credits toward high school graduation, but they also can, in most programmes, earn between 14 and 18 credit hours per year. After high school graduation, these credits can be applied to a certificate or degree in a college programme at UNM-Gallup.

Source: University of New Mexico/Gallup ([128]), *Center for Career and Technical Education*, https://www.gallup.unm.edu/ccte/ (accessed on 25 July 2022).

The OECD Skill Strategy recommends increasing the quality of vocational education programmes (OECD, 2019[129]). This should be done by:

1. Providing comprehensive skills-development to enhance employability.
2. Integrating high-quality, work-based learning into all programmes.
3. Ensuring that there are sufficient teachers and trainers, and that they have both good pedagogical skills and up-to-date technical expertise.
4. Providing adequate quality assurance and monitoring of the labour market outcomes of education and training providers.

Entrepreneurship, the right education and skills

The growth of entrepreneurial activities in rural areas provides the necessary capital for diversification of the local economy, primarily through the development of the secondary and tertiary sector (Josipović and Molnar, 2018[130]). According to the Northwest New Mexico Council of Governments (NWNMCOG), Gallup has significant opportunities to attract new retail, dining, and lodging establishments through a combination of chain business attraction and start-ups (Williams, Howe and Grey, 2021[100]). The *New Mexico's Cultural Economy 2014* report from the University of New Mexico's Bureau of Business and Economic Research found that Gallup and McKinley County had the highest percentage of workers engaged in the cultural economy (Mitchell and Joyce, 2014[131]). In addition, artisans play a major role in the city of Gallup's economy. The trade in arts and crafts is a substantial part of the underground economy. A good portion of the artists enter the market from home, others sell at fairs and festivals, and 45% of artists sell their goods through traders (Williams, Howe and Grey, 2021[100]). Despite these opportunities, NWNMCOG, in their *2020-2025 Comprehensive Economic Development Strategy,* identified the lack of an entrepreneurial culture as a key weakness for local economic development, portrayed as "a relative lack of entrepreneurial knowledge and experience" (Williams, Howe and Grey, 2021[100]).

Innovative approaches and new partnerships between local governments and the business community are needed to maximise their potential. Scaling up education and training to enhance entrepreneurial and innovative initiatives locally is a multi-dimensional effort. It cannot happen unless higher education institutions include engagement with business and communities in their core functions. For example, Shimadzu Scientific Instruments (SSI) and Northern Michigan University (NMU) have partnered to

establish the Shimadzu Analytical Core Laboratory for Medicinal Plant Sciences. Through this collaboration, SSI has donated laboratory equipment to support NMU's first-in-the-nation medicinal plant chemistry programme. This rigorous chemistry programme gives students and faculty access to cutting-edge equipment and technology to conduct medicinal plant research (Shimadzu, 2019[132]).

The basis of rural entrepreneurship is the combination of locally specific resources aimed at creating value added for entrepreneurs and for the rural economy as a whole (Josipović and Molnar, 2018[130]). Columbiana views entrepreneurship training and education as a key element in promoting business start-ups. Discussions in the region revealed efforts to build a vibrant entrepreneurial culture and early-stage entrepreneurial education at the high school. Activities such as "shark tank" style competitions with students and connecting the students to community leaders and industry through projects help to develop a "start-up mindset" among students. Specifically, in the entrepreneurial class at the local high school, students execute projects for businesses. Guided by their teacher they are able to design, develop and execute an idea. These initiatives do not just bolster the skills of the students, they also help instil pride in the community and empower young people. There are also efforts to create a culture to support entrepreneurs by providing awards to businesses.

The OECD Inclusive Entrepreneurship Policy Assessments across the EU found that entrepreneurship education and training are often part of schemes to support the unemployed in business creation (OECD/EC, 2021[123]). Additional benefits of this type of policy are more positive self-perceptions and increased self-confidence, especially among disadvantaged groups. The effectiveness of entrepreneurship training can be increased by tailoring content and methods to the particular skills needs of the target groups (EU/OECD[133]). In Gallup, through the work of the Navajo Technical University (NTU), Navajo Nation students are being exposed to new technologies and opportunities. The Navajo Nation is one of the largest federally recognised tribes in the United States. However, more than 40% of tribal members live below the poverty line. NTU's Advanced Rural Manufacturing programme is a state-wide collaboration between industry, academia, and government to bolster the Navajo economy with technological innovation. It aims to empower Navajo students and provide them with access to first rate technology and tools. As part of the NTU programme, students learn about advances in the design of technology and related business aspects, such as how products are financed and introduced to the market. The initiative includes "hands-on" K-12 school programming, advanced manufacturing and entrepreneurial training, internships, and technology transfer programming (NTIC[134]).

Annex 4.A. Local population indicators

Annex Table 4.A.1. Population and economic indicators for three local communities

	Gallup, New Mexico	Pine Bluff, Arkansas	Columbiana, Ohio
Population and demographics (age and sex)			
Population estimates, 1 July 2021 (V2021)	21 495	40 244	6 694
Persons under 18 years, percent	31.2	22.8	17.6
Persons 65 years and over, percent	13.3	15.2	31.1
Female persons, percent	51.6	52.8	56.1
Population identifying with a certain race and Hispanic origin			
White alone, percent	31.5	19.6	94.6
Black or African American alone, percent (a)	1.4	76.0	0.0
American Indian and Alaska Native alone, percent (a)	47.7	0.3	0.0
Asian alone, percent (a)	3.2	0.9	2.3
Native Hawaiian and other Pacific Islander alone, percent (a)	0.4	0.6	0.0
Two or more races, percent	6.5	1.9	1.6
Hispanic or Latino, percent (b)	30.6	1.4	2.4
White alone, not Hispanic or Latino, percent	18.9	19.1	94.1
Housing			
Owner-occupied housing unit rate, 2016-20, USD	135 500	74 900	156 300
Households			
Persons per household, 2016-20	2.82	2.28	2
Computer and Internet use			
Households with a computer, percent, 2016-20	80.2	86.5	89.0
Households with a broadband Internet subscription, percent, 2016-20	68.3	67.0	87.1
Education			
High school graduate or higher, percent of persons age 25 years+, 2016-20	84.1	86.2	96.3
Bachelor's degree or higher, percent of persons age 25 years+, 2016-20	20.9	19.6	31.1
Health			
With a disability, under age 65 years of age, percent, 2016-20	11.3	14.4	5.1
Persons without health insurance, under age 65 years, percent	17.9	7.2	2.0
Economy			
In civilian labour force, total, percent of population age 16 years+, 2016-20	52.9	52.3	62.4
In civilian labour force, female, percent of population age 16 years+, 2016-20	52.2	54.2	51.9
Total health care and social assistance receipts/revenue, 2017 (USD thousands)	397 386	372 767	NA

	Gallup, New Mexico	Pine Bluff, Arkansas	Columbiana, Ohio
Total transportation and warehousing receipts/revenue, 2017 (USD thousands), USD (c)	40 952	38 665	D
Total retail sales per capita, 2017, USD (c)	33 732	14 965	39 636
Transport costs			
Mean travel time to work (minutes), workers age 16 years+, 2016-20	13	17.7	25.3
Income and poverty			
Median household income (in 2020 USD), 2016-20	45 754	34 410	44 095
Per capita income in past 12 months (in 2020 USD), 2016-20	21 231	19 240	35 621
Persons in poverty, percent	33.7	25.4	12.5
Businesses			
All employer firms, reference year 2017	762	725	166
Men-owned employer firms, reference year 2017	321	378	104
Women-owned employer firms, reference year 2017	116	74	34
Minority-owned employer firms, reference year 2017	166	121	S
Nonminority-owned employer firms, reference year 2017	418	412	139

Note: (a) Includes persons reporting only one race, (c) Economic Census - Puerto Rico data are not comparable to United States Economic Census data, (b) Hispanics may be of any race, so are also included in applicable race categories.
Value Flags: S= Suppressed; does not meet publication standards; NA= Not available; D=Suppressed to avoid disclosure of confidential information.
Source: United States Census Bureau (2022[135]), *QuickFacts: Columbiana City, Ohio; Gallup City, New Mexico; Pine Bluff City, Arkansas*, https://www.census.gov/quickfacts/fact/table/columbianacityohio,gallupcitynewmexico,pinebluffcityarkansas/HSG495220#HSG495220.

Columbiana, Ohio

A former steel town facing population decline

Historically Columbiana was integrated into the steel industry located along the Mahoning River until the late 1970s. Columbiana specialised in constructing the wooden patterns used to create moulds for casting steel. Unlike much of Northeastern Ohio, which has experienced significant population decline since 1980, Columbiana experienced a slow increase in population. On the other hand, the population of Columbiana County peaked at 113 000 in 1980 and is now about 102 000. While most of Columbiana is located in Columbiana County, a small part in the north of the city is in Mahoning County.

Metal fabrication remains an important part of the local economy and it is supplemented by a growing logistics sector. Both short stay and day-trip tourism is expanding, and the city has started to attract new residents from the Pittsburgh MSA as houses become more expensive there and possibilities for hybrid work increase.

On the other hand, with a population of under 7 000 and close proximity to the larger communities of Boardman, East Liverpool and Salem, Columbiana does not have a strong retail sector. For example, the closest Walmart or Home Depot is in Salem. This means that a large share of retail sales leak out of the community. Similarly, while there are several urgent treatment centres in Columbiana, the closest hospitals are in Salem and Boardman. Rural communities of similar size in relatively densely settled regions face a similar situation, but it does limit some sources of economic growth.

Columbiana adopted a city manager form of government in the 1970s and has only had three city mangers since then. City managers are unusual in smaller cities where the common form is a mayor and city council

who share administrative responsibilities. Most places are unwilling to delegate that much authority to an employee, nor are communities that rely upon either volunteer or nominally paid elected officials prepared to pay for a professional manager. However, with part-time elected officials there are often major administrative issues and there can be a lack of continuity in decisions. A clear benefit for Columbiana from having a long-tenured city manager is his ability to master grant applications and knowing which entities can be approached for a particular source of funding. While it may be possible to hire consultants to support grant applications, doing so entails a direct financial cost and provides no continuity, and the city manager is able to follow through both in implementation and on reporting results to the grant provider.

Columbiana has adopted a number of public sector behaviours that contribute to its growth capacity. While these exist in some other rural places, they are not common. In addition, the combined effect of multiple governance innovations is likely leading to significant synergies and complementarities that contribute to improved development.

Collaboration and engagement

Collaboration in communities is one of the keys to fostering innovation, and it can be fostered by third party facilitators such as civil society/NGOs or community development organisations. In Columbiana, both public officials and business leaders are engaged with the local schools, including the primary school (elementary school), in an effort to create an environment where students see Columbiana as a place where they might like to live, and to provide students with a sense of what employment opportunities are available locally. In response the high school has hired a teacher who teaches classes on entrepreneurship and business skills. Additionally, the city engages with students both to get their input on recreation facilities and to allow them to play a role in how Main Street is to be redeveloped. Efforts by the city government to engage the students and the efforts by the school system to support that engagement have generated reports of students feeling pride and investment in their community, building enthusiasm for reinvesting in and contributing to the community as adults.

Key assets and opportunities

Most small rural communities rely solely on grants for financial support because their fiscal capacity is so small that they must spend it all on current outlays that are mandatory. With no internal investment funds, they face two challenges. The first is they can only obtain funds to invest in projects that grant makers are currently prepared to fund, which limits their activity. Second since most rural places are in this situation, competition for these funds is intense and many applicants do not receive funding. However, Columbiana has made a strong effort to build internal investment capacity over time, which allows it to apply for “cost-shared” programs that have fewer applicants and are also preferred by many grant providers, since they both leverage the grant providers money and have inherently lower risks. This has given the city the opportunity to make both more investments and a broader range of investment than is common in rural America. Further, in many communities, relationships between local government and developers are problematic. In Columbiana, there is strong partnership between the local government and the private developer who is building housing and retail development on the old Firestone Farm. This major development is creating a new retail and recreational complex as well as new housing. The City government has found ways to restructure local regulations to encourage development. Two examples are illustrative. The first was the creation of a local ordinance to allow people to carry alcoholic drinks in public during specified city events. Typically, in Ohio walking and drinking on public property is illegal. This ordinance is used to allow alcohol sales when events are held on Main Street as it is closed to traffic, or in other public venues. Allowing alcohol sales both increases vendor sales and causes more people to participate, which creates a better sense of community. Second the city has pioneered a reduction in local and school taxes for new homes. City taxes are reduced for the first 15 years of occupancy as a mechanism to make home ownership more attractive in Columbiana. Lower property taxes reduce the monthly cost of

home ownership, which has attracted more people from higher cost areas near Pittsburgh. While local schools lose some money in the short term, the influx of people has led to more housing being constructed and to higher property values in general.

Culture has also been a source of community cohesion and attractiveness. The Columbiana Cultural Collective is transforming the Main Street theatre into a community arts hub. The theatre had been rehabilitated about 15 years ago and served as location for amateur theatre productions, concerts and other events but closed with COVID shutdowns. Not only is the theatre a dominant part of the downtown streetscape but it has been vital in bringing people in the community together over multiple decades. The Collective is working on a plan to raise funding over five years to buy the building from a benefactor who purchased it with the intent to sell it to the Collective at a discount from the purchase price. The collective is a good example of an innovative social enterprise that has leveraged private philanthropy to provide a window of opportunity to assemble the funds to ensure the theatre remains a key part of the community and provide additional opportunities for cultural events.

Finally, a clear advantage of Columbiana is a strong K-12 school system. Strong local support for schools, both financially and in terms of community engagement, has resulted in better school performance than for proximate peer districts. The strategy of attracting nearby households is helped by both the lower cost of housing and good local schools. In addition, the city is investing in improving its visual attractiveness through a Main Street revitalisation programme and by creating better parks and recreation facilities. The city is fortunate that it received a large tract of land from the estate of Harvey Firestone to establish a multi-purpose park near one of the new housing developments.

Examples of innovative private enterprise

Typically, innovation is seen as a business opportunity where a new product or process is introduced into the marketplace. Many of the manufacturing firms in Columbiana are adapting to changing conditions, though mainly in incremental ways. However, several are implementing significant innovations that are increasing productivity and their competitiveness.

Humtown Products is a third-generation family firm that has embraced additive manufacturing and radically redesigned its labour relations processes to increase worker engagement and foster team production. The firm is engaged in producing moulds and cores for metal casting using sand as the medium. One part of the company has shifted to using 3-D printers to form the moulds, and now has the most sand printers in the country. The other part of the firm uses more traditional core and mould production processes but has installed monitoring technology on most of its machinery that show individual operators their real-time production rate displayed as an effective hourly wage. As operators increase output without an increase in scrap rates they earn more money. In addition, each operator’s performance can be compared to other workers doing the same task. While the base hourly rate remains set by historical performance levels, the current rate is much higher as operators learn from each other and have an incentive to improve productivity. Since machine operator performance is affected by supporting workers, such as forklift drivers and packers, they too are provided with performance bonuses as output increases.

Humtown Products was named the 2020 Manufacturer of the Year by the National Association of Manufacturers in the small to medium-sized enterprise category. They have developed collaborative relationships with the local schools, including the use of gamification to help teach 3rd and 4th grade students problem-solving skills at Crestview Local Schools.

Pine Bluff, Arkansas

An industrial and agricultural economy facing population decline

The population in Pine Bluff peaked at 57 400 in 1970 and has declined rapidly since 2000. The city is about an hour away from Little Rock, the state capital, and is part of the Little Rock Combined Statistical Area. Pine Bluff is served by the Union Pacific Railroad and the Port of Pine Bluff on the Arkansas River provides a connection to the Gulf of Mexico via the Mississippi River. A network of federal and state highways connects the city to the larger region and to the national Interstate Highway System. Currently there is no scheduled air service to Pine Bluff.

Pine Bluff has experienced a significant economic decline in the last 30 years as much of its economic base eroded. While agriculture in the Delta region remains important, it offers far less employment than in the past and farm consolidation has caused a decrease in the rural population. Forest products, which once was a significant industry, has also declined, particularly the local pulp and paper mills. Union Pacific no longer has a service depot in the community and employment at the Pine Bluff Armory has dwindled. Much of Pine Bluff's role as a regional retail and service hub has also disappeared as Little Rock has grown and expanded its retail trade area into communities that used to be served by Pine Bluff. Economic decline has led to accelerating population decline, a falling local tax base, decreasing property values, increases in empty and dilapidated housing and retail establishments, and city infrastructure that is both deteriorating and too large for the current size of the community. With economic decline human and financial capital has left the community as people with higher skills relocated to growing parts of the state and other parts of the country.

Key assets and opportunities

Pine Bluff has several key strengths that are being mobilised as part of a major redevelopment effort. These include:

- Two strong higher education institutions, the University of Arkansas at Pine Bluff (UAPB) and Southeast Arkansas College (SEARK), that are fully engaged with local leaders in efforts to rebuild the local economy. UAPB is a four-year school with a historically Black student population and a significant research programme, while SEARK provides a 2-year associate's degree and a broad range of technical education programmes to students.
- Simmons Bank, a major regional banking organisation, was founded in Pine Bluff and has expanded its operations to seven states. Its corporate headquarters remains in Pine Bluff and is the only large commercial business in the city core. Notably, Simmons has made a number of large investments in the revitalisation of Pine Bluff, including large financial commitments from the Simmons Foundation. While part of this support can be explained by the bank fulfilling its Community Reinvestment Act (CRA) obligations, the level of support goes well beyond the amount CRA would require.
- A high degree of racial harmony in the community. About three-quarters of the city population is African American. African Americans hold all of the elected positions in the city and county, with both Black and white community members being engaged in leading community organisations.
- Strong co-operation between elected officials in the city and county governments.
- Widespread recognition across the community that major reinvestment is required for Pine Bluff to survive. While some debate still exists over how this is to be accomplished, there is general support for change.
- Significant progress in removing or renovating commercial buildings in downtown and cleaning up and renovating neighbourhoods.

On the other hand, Pine Bluff faces major challenges, including:

- A dysfunctional local school system that is under the control of the state government because it has performed so poorly in the past.
- High rates of poverty, low levels of employment and a workforce with poor skills, especially those needed for the modern economy.
- A considerable number of large commercial buildings in the city centre that are in poor condition and are unlikely to ever return to their original use. This leaves the question of whether it is better to demolish them or rehabilitate them. In either case there is typically no clear sense of what use is appropriate for the location.
- Identifying a new economic function for the city and county that will support local objectives for better employment opportunities and higher incomes.
- A deteriorating housing stock that leads to falling home values that reduces household wealth.

The Go Forward Pine Bluff (GFPB) development approach

The Go Forward Pine Bluff (GFPB) development approach is the central part of efforts to revitalise the community. It can be seen as an innovative response to a systemic redevelopment challenge, and while it has yet to demonstrate its success it already provides useful examples of how to undertake a comprehensive approach to renewal. The effort started in early 2015 when a group of citizens formed to try to develop an initiative to revive the city's downtown, which had been seen as an impediment to attracting new investment in any part of Pine Bluff. Beyond removing urban blight, they identified three underlying problems that were interconnected: inadequate housing, poor workforce skills and a weak education system. Resolving these issues was seen as a necessary precursor to restoring economic growth.

This in turn led the group to try to create community support in early 2016 for a locally supported initiative to identify a community development strategy. The group solicited volunteers who would make a one-year commitment to work for several hours each month on one of four themes – economic development opportunities, education reform, improving quality of life, or improving government and infrastructure. Through 2016, 100 community members, with support provided by the steering committee, developed a draft plan. The result, in the form of 27 key points, was presented at an open community meeting at the end of 2016 and was broadly endorsed by the large number of attendees.

The strong community support at the meeting led to the local business community raising $18 million to support the implementation of the plan. With this support in place the city voted in a referendum in 2017 to increase the local sales tax to fund an implementation programme. The vote was 69% in favour and Go Forward Pine Bluff (GFPB) was created to manage the initiative with seven years of funding. Since 2018 various entities have been created or revised by GFPB to carry out specific programme tasks. Currently about 96% of the set of key points identified at the community meeting are in varying stages of progress. COVID slowed progress significantly for two years and now with funding ending in 2025 there is more pressure to complete the tasks.

Four challenges limit the speed of work. The first is that GFPB must rely on the city (and to a lesser extent the county and state) to actually implement many of the recommendations, and government priorities are not always aligned with those of GFPB. Second, private investors who will make the bulk of the investments have been unwilling to commit funds until more progress has been made to ensure their investment is viable. Third, the amount of work involved is difficult for a small paid staff and a limited number of volunteers to carry out. As the end of the funding period approaches, it becomes harder to attract paid workers even as they become more necessary because their job tenure is short. Finally, while GFPB has a strong vision of how the community of Pine Bluff can evolve, it has not clearly identified an economic development

strategy that will generate the employment opportunities needed to take advantage of the up-skilling of the workforce and revitalisation of the city.

The set of key points endorsed by the community in 2016 cover a wide range of potential activities. Some must be accomplished before others, some are simpler to implement, and some require other actors, such as city government to carry out. Importantly, some are more innovative than others, but all are necessary. Given the magnitude of the decline over recent decades virtually all the things being done by Go Forward Pine Bluff (GFPB) involve constructing a platform on which economic development can occur. Some of the main elements of this foundation that are being implemented to date are discussed below.

The Generator. Simmons Bank provided a downtown building that could be rehabilitated to house a multifunction technology centre that also hosts classes for nascent entrepreneurs. The Generator operates after-school programmes and well as school field trips to expose primary (elementary) school students to computer technology and encourage their interest in developing digital skills. This is especially important in Pine Bluff where schools lack up-to-date technology and many homes cannot afford to provide it. Also, in a community where local entrepreneurs are not visible, the Generator provides support for small cohorts of people who wish to explore becoming an entrepreneur. The focus of the programme is on helping the individual identify a potentially viable business model and helping them assess whether they truly want to commit to being an entrepreneur.

Downtown Revitalization. This programme combines a number of fairly standard elements into an integrated approach. Improving the physical appearance of downtown is essential to convince both the local population and potential external investors that a viable future is possible. Crucially, GFPB recognises that the population of the city is likely to continue to shrink and this means that the structure of the city should adjust to conform to its smaller size. In this process, there is an opportunity to reconfigure the form of the city so that it better serves new conditions. In particular, increasing the amount of high-quality affordable housing is seen as a necessary condition to attract both external workers with higher skills as well as firms that can employ them.

Restoration of smaller commercial buildings that are in relatively good condition has occurred and some of these are now operating again. Other small commercial buildings that were in poor condition have been demolished. A streetscape programme has restored and expanded sidewalks. Several large commercial buildings have been purchased and their exteriors have been stabilised while potential new uses are explored. Where uses cannot be identified, the buildings will be removed and the land converted into housing, among other uses.

Crucially the large number of dilapidated buildings in the city centre provides an opportunity for new urban housing in neighbourhoods that span multiple city blocks. New urban core housing will only be viable if there is additional public investment in creating parks and public buildings like libraries, recreation centres and other public services. Since Pine Bluff is also the county seat for Jefferson County it has both city and county facilities, and it already has several major public buildings, including the library and aquatic centre in its downtown. While the high school is currently downtown residents are concerned that it may be relocated to a suburban site where construction costs will be lower but the amenities and accessibility of the city centre will be lost.

Renovating and Repurposing Suburban Neighbourhoods. Much of the older suburban housing stock is severely dilapidated. In some blocks most of the housing is in poor condition or abandoned. In other blocks the number of severely dilapidated houses is relatively small. With limited funds for housing redevelopment GFPB is trying to demolish housing on contiguous blocks where conditions are the worst and intervene in blocks where slowing blight will encourage reinvestment. Reducing the amount of poor-quality housing in older suburbs helps to improve the market for new urban housing and can provide opportunities for alternative land uses.

***Preparing the Workforce for a Digital Economy*.** While GFPB has no direct influence on the school system it does serve as a forum for community concerns by improving educational outcomes. GFPB also works with the two local institutions of higher education in Pine Bluff: the University of Arkansas - Pine Bluff (UA-PB) and Southeast Arkansas College. Both institutions have expanded programmes that provide technical skills and can increase employment prospects. Both attract a large number of local graduates who are seeking post-secondary education. Retaining these students however hinges on improved prospects for local employment.

In particular, SEARK has recently entered into a partnership with People Source, a public benefit corporation that provides training and staffing services for private companies. People Source will locate on the SEARK campus and is expected to employ about 250 people, some of whom will be students. Because People Source has offices in Arkansas and several adjacent states it has a strong sense of emerging career opportunities and the capacity to help students prepare for those jobs. This will also help SEARK identify areas where it can adjust its curriculum to better match graduates' skills with employers' needs.

Working beyond the City. Pine Bluff remains the largest city in southeast Arkansas and its local labour market extends beyond Jefferson County, particularly to the southeast. It is already a regional and higher education centre and its local labour market extends out about 60 miles from the city. With more retail and service providers it has the potential to serve an even larger retail trade area. For this expanded role to be possible, Pine Bluff will have to work with Jefferson's County officials and elected leaders in the ten other counties in the South East Area Economic Development District, and particularly with Cleveland and Lincoln counties that are part of the Pine Bluff MSA. GFPB has already developed a strong working relationship with Jefferson County.

Fostering entrepreneurship

Currently the rate of entrepreneurship in Pine Bluff is low, particularly in the African-American community, which comprises the bulk of the population. Fostering a higher rate of entrepreneurship is important for several reasons. Most importantly it offers a potential path out of poverty if the business is successful. Second, a larger business community offers a group of potential leaders for the community. Third, a larger number of locally owned businesses expands the range of locally available goods and services in the community. Even if the firms do not offer many jobs, their presence improves the local quality of life.

GFPB has focused on helping women entrepreneurs start their own businesses, including home based businesses. While motivations vary, some women found that self-employment was more amenable to work-life balance in the labour market. This is especially salient in places where access to work-life balance support schemes (such as child-care facilities) are limited. Their potential is also enhanced by the common finding that women now have higher levels of educational attainment than men, which provides them with stronger formal education. GFPB holds classes at the Generator as a training site to help small groups of nascent entrepreneurs get ready to begin an enterprise. Recently UA-PB received approval to host a Small Business Administration-sponsored Small Business Development Center, which will add resources for the next step of actually starting a business.

Importantly, the entrepreneurial classes connect potential entrepreneurs with local lenders. It provides them with direct experience on how to finance their business. Because many of the entrepreneurs are minorities, local banks can use money from their Community Reinvestment Act (CRA) requirements to offset losses associated with startups. This makes it easier for entrepreneurs with limited wealth to get started.

A challenge for new entrepreneurs, particularly those with only limited ties to the financial industry is understanding how financial intermediation works. Similarly, banks often have little incentive to engage with potential borrowers who will require a large investment of time and resources to make only a small loan. GFPB plays the role of an intermediary by only bringing borrowers that it has worked with to bankers

and other lenders who see there is a social benefit to the community if they can help a viable business get off the ground. Certainly, the fact that CRA encourages banks to make this type of effort is also useful.

GFPB also engages with other entities that can provide financing for entrepreneurs. This is critical because banks can only provide debt financing that is secured either by the wealth of the entrepreneur or by some other financial intermediary pledging collateral. For example, federal government loan guarantees provided by USDA, SBA or other agencies reduce lender risk exposure and can lead to a greater willingness of a bank to lend. Another type of financial intermediary with a broader local economic development mandate, such as a Community Development Financial Institution (CDFI), or Community Foundation, may also be able to provide funding either as a grant, a subsidised loan or some form of equity investment (Freshwater, 1990).

Gallup, New Mexico

A city deeply connected to the Navajo Nation in the midst of energy economy transition

The city population has been relatively stable over the last few decades, with only limited growth. Notably, a large share of the population are Indigenous people living off-reservation. The Gallup retail trade area extends deeply in the Navajo Nation and the city is a hub for both shopping and government services provided to people on living on the reservation. It has also been a major hub for Native crafts, particularly silver jewellery and weaving. The city is located on Interstate 40 and is also on the Burlington-Northern Santa Fe east-west mainline from Los Angeles.

Gallup recognises that it must identify new economic functions to replace fossil fuel extraction if it is to prosper. Its role as a service centre for the Navajo Nation and other tribal communities will remain important, as will tourism; but a new function that offers full-time, higher paying jobs is desired. Gallup sees an opportunity in its location on both a major east -west interstate and on the BNSF east-west rail mainline as a way to first develop a strong logistics industry and then leverage that to introduce manufacturing. In addition, the presence of existing rail and road infrastructure, Gallup is roughly and 11-hour drive from the ports of Los Angeles and Long Beach. After 11 hours of driving commercial trucks are required to stop for a rest period, which makes Gallup an ideal location for both a maintenance site and for a transhipment hub. With a logistics hub there is potential to attract light manufacturing firms, which would add another dimension to the city's economic base.

Collaboration and engagement

Many EDA economic development districts are characterised by only limited interactions among the multi-county entities and local governments. In the case of the Northwest New Mexico Council of Governments there is far greater collaboration and the COG carries out a number of functions that might normally be the direct responsibility of a county. In part this is because the COG is authorised by the state to carry out more functions than economic development and transportation planning. But this authorisation exists because member governments have concluded that it is in their interest to have one entity with specialised knowledge that allows it to be more effective carrying out extra functions. These include environmental planning, water planning, energy efficiency initiatives and obtaining grant funds for a range of technical support activities. The COG has developed a common approach and model to maximise its impact and effectiveness while being able to customise and adapt to capture and deliver on place-based strategies and opportunities.

Key assets and opportunities

Located within a one-hour drive from Gallup, the Navajo Technical University trains Tribal youth in STEM related disciplines. The Center for Advanced Manufacturing was created to provide more specific and job focused experience for students in additive metal manufacturing. Because there is varying experience in manufacturing on the Navajo Nation it was felt that the best opportunity for success would be in a new field where leading regions have yet to emerge. The programme has invested in creating labs with modern equipment for students to use for training with the objective of creating entry level skilled technicians. In addition, the centre partners with a number of universities and national laboratories to provide internships for its students and research opportunities for their graduate students and post-docs. This two-way flow increases the chances for employment of Native youth and may encourage new start-ups to be developed by individuals coming to the Navajo Nation to conduct their research.

The Greater Gallup Economic Development Corporation (GGEDC) workforce development programme has developed and implemented its own tailored workforce development programme due to local dissatisfaction with the available options. Local employers were unhappy with training programmes, particularly those focused on menial skills. In addition, employers wanted more female workers than were available. The programme starts by requiring participants to get a GED certificate if they don't already have one. The core curriculum is drawn from the National Center for Construction Education and Research (NCCER) curriculum, which is centred on providing students with basic skills before proceeding to a series of modules that are applicable to specific tasks or responsibilities. This allows each student to tailor their studies to a specific occupation and potentially to an employer. Many of the module sequences can be used as an entry point for a formal apprenticeship in skilled trades once students gain more experience.

The Navajo-Gallup water supply project is a long-standing collaboration between the Navajo Nation and the City of Gallup to improve the local supply of water by building an aqueduct from the San Juan River (USBR, n.d.[136]). The impetus for the project was a settlement in 2009 on a decades-long legal battle over water rights. The Navajo Nation advocated that it was entitled to an increased share of the water in the river. The settlement made it possible for the Navajo-Gallup Water Supply Project to begin in earnest. Construction of the project is only now underway, due to major problems both in securing funding and is establishing rights of way across land parcels that were held by a large number of owners. Joint work by the city, the Council of Governments and the Navajo Nation slowly overcame these obstacles. This long-term collaboration has created the opportunity for additional co-operation between the Navajo Nation and the city, even though their interests differ at times (USBR, n.d.[137]).

There is a proposed joint Indian Health Service and community hospital. Additional medical facilities are needed both by Gallup and the Navajo Nation. The Indian Health Service, a federal agency, has prioritised the construction of an area inpatient hospital that could be built as a healthcare campus to expand services to behavioural health, dialysis, and many other services. The community has also discussed consolidating its community hospital, Veterans Affairs clinic and other health services on this campus, as well as how to attract medical supply and manufacturing firms for additional job creation.

Providing broadband in rural areas is expensive due to large distances and small populations. In the Gallup area, costs are even higher because of fragmented land ownership, which increases the cost of obtaining rights of way for copper or fibre lines. Sacred Wind Communications began serving the Navajo Nation in 2009 using fixed wireless, which is cheaper to install and avoids easement issues. The company has a contract to provide internet access to schools. Under the agreement, the infrastructure can serve as a beach head from which the company can build out additional capacity to serve houses and businesses in close proximity to the school.

A local bike shop in Gallup (the Silver Stallion) was interested in improving health conditions among Tribal youth. They recognised that while it was possible to get grants to buy bikes for distribution on a reservation this would not have much impact. Instead, the company worked with a local school to create a bike riding

club as part of the physical education programme. In addition, the company connected with school social workers who saw that communal bike riding could help children with social problems. The programme became part of Outride, which is a national organisation that supports this type of school-based cycling programme. The bikes remain at the school and students start by going on shorter supervised rides to gain experience, confidence and interest. Over time some students become interested in competitive bicycle racing and can compete at a local and regional level.

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Notes

[1] The term “connectivity divide” is used to refer to gaps in access and uptake of high-quality broadband services at affordable prices in areas with low population densities and for disadvantaged groups compared to the population as a whole (OECD, 2021[71]).

[2] The role of communication networks as an accelerator of development has been recognised globally. For example, the task of making the Internet universal and affordable is found in target (Target 9.c) of the Sustainable Development Goals (SDGs) (UN, 2015[141]).

[3] The authors use a fuzzy regression discontinuity design as an identification strategy and focus on policies in the United Kingdom (DeStefano, Kneller and Timmis, 2022[9]).

[4] The authors estimate propensity score matching and endogenous treatment effect models to control for innovation orientation and find evidence of cloud adoption enables various types of innovation using the 2018 Annual Business Survey of the United States.

[5] Permanent indigenous settlements in the Southwest of the United States thought to be descendants of a prehistoric Native American civilization, also known as Anasazi, that existed from approximately AD 100 to 1600 (Encyclopaedia Britannica, 2020[142]).

[6] The National Congress of American Indians presented some caveats concerning the American Indian and Alaska Native (AI/AN) population counts collected and released for the 2020 Decennial Census. Given the challenges presented in 2020 due to the COVID-19 pandemic, as well as several natural disasters, tribal lands without broadband access were unable to respond the 2020 Census, which may lead to measurement errors (NCAI, 2021[143]).

[7] See “Appendix E: Deployment of Fixed Terrestrial Fixed 25/3 Mbps and Mobile 4G LTE with a Minimum Advertised Speed of 5/1 Mbps Services By State and County Segmented by Urban and Rural Areas (December 31, 2019)” (FCC, 2021[15]).

[8] Pine Bluff enjoys a strategic geographical location connected by interstate and national roads, the Union Pacific Railroad, a regional airport, and seaport in the Arkansas River. Given its location, it is still a foreign trade zone. In the early 1900s, it was an economic prosperous region (e.g. Simmons Bank, a large bank present in several states, was founded in Pine Bluff in 1903).

[9] See “Appendix E: Deployment of Fixed Terrestrial Fixed 25/3 Mbps and Mobile 4G LTE with a Minimum Advertised Speed of 5/1 Mbps Services by State and County Segmented by Urban and Rural Areas (December 31, 2019)” (FCC, 2021[15]).

[10] Concerning the demand for high-quality broadband, the Executive Director of the innovation hub stated, "*At the Generator, we know how important fiber internet is to economic development and entrepreneurship. Not only does it enable cutting-edge businesses, but fiber internet makes it more attractive to move to an area; apartments fill faster, and housing values go up. This will help with attracting and growing our skilled workforce, and with our ability to attract tech entrepreneurs to Pine Bluff, grow existing businesses and especially retain entrepreneurs in the community*" (Go Forward Pine Bluff, 2020[19]).

[11] See "Appendix E: Deployment of Fixed Terrestrial Fixed 25/3 Mbps and Mobile 4G LTE with a Minimum Advertised Speed of 5/1 Mbps Services By State and County Segmented by Urban and Rural Areas (December 31, 2019)" (FCC, 2021[15]).

[12] Access to fixed broadband has the potential to deliver high-speed Internet services. The OECD definition of fixed broadband subscriptions refers to fixed subscriptions to high-speed access to the public Internet (a TCP/IP connection), at downstream speeds equal to, or greater than, 256 Kbps. This includes the sum of DSL subscriptions, Cable subscriptions, Fibre subscriptions, Satellite subscriptions, Terrestrial fixed wireless subscriptions and Other fixed broadband subscriptions (see the OECD's Broadband Portal section on Broadband Methodology - OECD). To capture the evolving nature of fixed broadband delivering higher performance, the OECD also has six speed tier categories (i.e. < [lower than] 2 Mbps; ≥ [higher or equal than] 1.5/2Mbps and < 10Mbps; ≥ 10 Mbps and < than 25 Mbps; ≥ 25 Mbps and < 100 Mbps; ≥100 Mbps and < 1 Gbps; ≥ 1 Gbps).

[13] This indicator represents a weighted average of data usage trends for both flat-rate billing and usage-based billing fixed broadband subscribers. OpenVault's platform captures broadband usage data from millions of residential and commercial subscribers across the United States and Europe, from more than 150 service providers. The data presented here concerns the United States (OpenVault, 2022[25]).

[14] The Internet of Things includes all devices and objects whose state can be altered via the Internet, with or without the active involvement of individuals. While connected objects may require the involvement of devices considered part of the "traditional Internet", this definition excludes laptops tablets and smartphones already accounted for in current OECD broadband metrics (OECD, 2018[144]).

[15] Wireless mobile networks have four main elements: the core network (i.e. backbone), the transport network (i.e. backhaul), the radio access network (RAN), and the users' terminal device. The core connects to the access network through backhaul, and the RAN connects to the users' terminal device via the air interface (spectrum) (OECD, 2022[5]). First (or last mile) networks carry telecommunication data from the customer to an antenna or local switch. Backhaul networks carry the traffic of the first mile networks (DSL, cable, mobile) towards central switching locations and to their final destinations. Backhaul networks can cover a city, a region or a country and are known under different specific names. Historically, the terms used for backhaul have included 'trunk networks', inter-local or long distance networks. Other terms such as "middle mile" and "metro". These terms do not, however, necessarily specify any specific network length or particular technological deployment. What is termed as a metro network in one context, for example, may be considered to be part of a backbone or core network in another (OECD, 2014[145]).

[16] Each source has a different methodology, and thus provides a different perspective of the Internet (OECD, 2022[5]).

[17] Data collection period: October 2021 to December 2021. Opensignal definition: "5G Download Speed shows the average download speed experienced by Opensignal users across an operator's 5G network. 5G Download Speed for each operator is calculated in Mbps (Megabits per second)." Opensignal notes

the following: "*Opensignal, a mobile analytics company, is the global standard for measuring real- world mobile network experience. Using billions of measurements collected 24/7 from tens of millions of smartphones, Opensignal analyses real-world mobile network experience at the largest scale and frequency in the wireless industry: by operator and country, regionally and world*wide". For more information please visit the Opensignal website (http://www.opensignal.com/).

[18] Data collection period: October 2021 to December 2021. Opensignal definition: "5G Availability shows the proportion of time Opensignal users with a 5G device and a 5G subscription had an active 5G connection".

[19] Out of 42 870 complaints filed to the FCC in 2021.

[20] See "Appendix H: Deployment (Millions) of Fixed Services (includes Satellite) at Different Speed Tiers in the United States (December 31, 2019)" (FCC, 2021[15]).

[21] For example, Commissioner Rosenworcel in her dissenting opinion of the Fourteenth Broadband Deployment report noted: "The FCC relies on information submitted by providers without a system to independently verify the data. Last year, this allowed one company overstate its service coverage by tens of millions of people. This year, one of the country's largest providers found that it too had overstated its coverage in thousands of areas" (FCC, 2020[146]).

[22] The limitations of this dataset should be noted as it presents the caveat of limited to no data points for many states where the OECD Territorial classification is not refined enough to identify rural areas. Please refer to Chapter 2 for further descriptions of each of the territorial classifications used in the report.

[23] Regions within the 38 OECD countries are classified into two territorial levels reflecting the administrative organisation of countries. The 433 OECD large (TL2) regions represent the first administrative tier of subnational government, for example, the Ontario Province in Canada. The 2 296 OECD small (TL3) regions correspond to administrative regions, with the exception of Australia, Canada and the United States. These TL3 regions are contained in a TL2 region, with the exception of the United States for which the Economic Areas cross the States' borders. For Colombia, Costa Rica, Israel and New Zealand, TL2 and TL3 levels are equivalent. All the regions are defined within national borders (OECD, 2020[150]).

[24] The OECD is strongly engaged with governments to address broadband connectivity challenges. Namely, within the Communication Infrastructure and Services Policy (CISP) unit, the OECD has conducted over 20 Telecommunication Policy country reviews in the past two decades. These reviews provide tailored policy recommendations on how to adapt the legal and regulatory framework to increase connectivity and access to high-quality communication services at competitive prices.

[25] One example is Mexico, increased competition since the Telecommunication Reform in 2013 led to a price decline of up to 84% in the mobile broadband market and added 72 million mobile broadband subscriptions from 2013 to 2020, which is the equivalent to slightly more than the combined population of Colombia and Chile. This allowed many people in Mexico – especially from low-income households – to connect to the Internet for the first time (OECD, 2021[71]).

[26] The Federal Communications Commission (FCC) is required to report every biennium an analysis of the state of communication market competition. On 16 May 2022, the FCC released a public notice seeking data for the 2022 Communications Marketplace Report (FCC, 2022[147]).

[27] Using the exchange rate of 0.846 EUR/ USD for the year 2021 from https://stats.oecd.org/.

[28] Idem.

[29] A public right of way permit is usually an agreement between the government and an applicant (OECD, 2008[148]). The granting of public rights of way usually requires the active participation of public authorities, often at different levels of government in managing or authorising the civil works needed in constructing ducts or other infrastructure required for networks.

[30] Using the exchange rate of 1.254 CAD/USD for the year 2021 from OECD.stat.

[31] Using the exchange rate of 1.414 NZL/USD for the year 2021 from OECD.stat.

[32] Small businesses (or small and medium enterprises) defined as having less than 300 employees using the "2020 SUSB Annual Data Tables by Establishment Industry", see https://www.census.gov/data/tables/2020/econ/susb/2020-susb-annual.html. The OECD ICT Access and Usage by business database harmonised with Eurostat classifies small firms as those with 10-49 employees and medium firms as those having 50-249 employees.

[33] The IIJA funding complements existing programmes managed by the NTIA for digital inclusion, such as the Broadband Infrastructure Program (USD 288 million), and the Tribal Broadband Connectivity Program (USD 980 million) directed to tribal governments to be used for broadband deployment on tribal lands).

[34] This category includes Alaska Native Corporations, Tribal Governments, Colonias, Persistent Poverty Areas and Socially Vulnerable Communities (USDA, n.d.[88]).

[35] Broadband was removed from Title II of the 1934 Communications Act (United States Congress, 1934[92]) in 2017, whereby broadband providers would be considered "common carriers". The implications of such move makes it unclear whether the FCC would be able to pursue an *ex- ante* regulation route.

[36] In her dissenting opinion concerning the RDOF, Commissioner Rosenworcel had said: "We need maps before money and data before deployment" (FCC, 2020[149]).

[37] Colleges refer to traditional 4-year degree programmes.

[38] One initiatives provided to support new entrepreneurs was through a public-public collaboration between the city and local downtown building owners that created small, pop-up spaces for aspiring entrepreneurs to test their markets and products affordably. The building owner offered one month of free rent to help entrepreneurs get started. It was reported that some of the entrepreneurs have been successful enough to sign leases for downtown spaces.

Additionally, an initiative that supported budding entrepreneurs in their pre-start-up period was a virtual tool called the "virtual storefront" which allows business owners to imagine what their storefront might be able to look like in context of the street.