Executive Summary, Jonathan Adelstein, President and CEO of WIA

By making resiliency a priority in the infrastructure plan, rather than limiting funding to a single, potentially less resilient, broadband technology, Congress can maximize disaster prevention, response, and recovery. A flexible all-of-the-above strategy, including fiber, fixed and mobile wireless improves redundancy and best employs this historic opportunity to achieve all Congressional broadband and climate change goals, not just one.

Congress should set agencies' funding goals, not set technological gating factors that preclude other priorities. Otherwise, Congress may tie agencies down with limited flexibility, preventing consideration of innovative and geographically appropriate provider applications that address many essential consumer needs beyond data speeds. Rather than cement specific broadband speeds in statute, Congress should set a checklist of priority factors including:

***Resiliency*:** Congress can instruct agencies to consider resiliency as a primary factor for funding. Applicants that provide resilient solutions are rewarded with priority consideration.
Higher download and upload speeds: Download and upload speeds are valued by consumers. Faster offerings deserve priority. In terms of symmetrical speeds, data show consumers use over ten times the downstream bandwidth compared to upstream. To make the primary gating criteria for eligibility a service most consumers do not require would foreclose providers from even applying that could better address many Congressional priorities and more urgent rural consumer needs.
Mobility: If wireless broadband is excluded, Congress could inadvertently grow a rural mobility digital divide. Many unserved residents would be tethered to accessing the Internet through a wired connection at the home or farmhouse. Fixed wireless supports 5G mobile broadband that is indispensable for rural Americans' daily needs, precision ag, and rural economic development.
Speed of deployment: Given the urgent need for broadband in rural areas, prioritize connecting consumers as quickly as possible provide flexibility to expert agencies to consider applicants that get networks up and running. Don't make consumers wait for many years by limiting the range of eligible providers. Future proof should not mean deployed far in the future.
Public safety and first responders: First responders rely on mobile networks as they go into harm's way to protect the public. Service to those who serve us all should be a priority goal.
Battling climate change*:* Congress can set as a priority factor for agencies the degree to which proposed projects will contribute to the reduction of carbon emissions. If only one technology is allowed, Congress would eliminate options like 5G that can best achieve this clear priority. Let the best technology win.
Targeting unserved areas: Congress should target funds to truly unserved areas. Define "unserved" areas as those lacking service through either wired or wireless technology. Accurate maps are needed to identify truly unserved areas with already committed build plans to target support.
Affordability: Limiting funding to wireline providers saddles smartphone-only consumers with the need to purchase costly new fiber service or require large ongoing federal subsidies. Few rural consumers are willing to give up mobility.
Cost efficiency: Technological flexibility provides consumers with the most megabits for the taxpayer dollar. No single technology is likely to garner a qualified applicant in every unserved area. Allow agencies flexibility to consider providers with the most appropriate solution for the given deployment. Ensure every awardee can cover its costs to remain viable so service and quality is maintained. Otherwise, the hardest areas to reach will fall into disrepair or remain unserved.

Congress has long expressed the value of each of these factors – and should not choose one as a gating criterion at the expense of all others. If rigid requirements, such as symmetrical speeds, are locked in statute, it precludes the flexibility to consider providers that address other key priorities including resiliency, an evolving mix of speeds, mobility, quicker deployment, public safety, climate change, and affordability for rural consumers. Lack of flexibility may leave many areas unserved.

Wireless Infrastructure Association

Testimony of

Jonathan Adelstein
President and CEO, Wireless Infrastructure Association

Before the

Subcommittee on Communications, Media, and Broadband
Committee on Commerce, Science, and Transportation
United States Senate

Hearing entitled

"Building Resilient Networks"

June 22, 2021

Chairman Lujan, Ranking Member Thune, and members of the Subcommittee, thank you for holding this important hearing and for the opportunity to testify. I am the President and CEO of the Wireless Infrastructure Association (WIA), representing the companies that build, develop, own, and operate the nation's wireless facilities. Our members include infrastructure providers, wireless carriers, equipment manufacturers, and professional services firms. WIA advocates for the widespread, responsible deployment of wireless infrastructure to enable mobile and fixed wireless broadband access for communities everywhere.

The wireless infrastructure industry is committed to making next-generation communications technology widely available to every corner of America. The importance of connectivity is dramatically underscored by the increased reliance on broadband during this unprecedented COVID-19 pandemic. WIA and our members are grateful for the leadership of your Subcommittee in promoting our shared goal of closing the digital divide with ubiquitous, reliable, resilient, and redundant broadband networks.

The Importance of Resilient and Redundant Networks During Pandemic

The focus of this hearing is on building resilient and redundant broadband networks. COVID-19 brought forth new challenges and new opportunities for broadband deployment. The pandemic created an even deeper recognition of how essential reliable broadband connectivity is to every household and to every business. The wireless industry's network investments enabled the entire economy to sustain itself during the pandemic. We helped businesses to stay afloat, children to continue learning, and first responders and health care providers to offer critical care.

Dramatic consumer usage changes, including work-from-home, remote learning, and telehealth, generated an unprecedented demand for wireless connectivity anchored by the need for wireless infrastructure. Wireless networks rose to the challenge and performed magnificently. U.S. networks' performance during the pandemic continues to demonstrate why our networks are the

envy of the world. COVID-19 drove mobile traffic up 20 percent, essentially overnight. Yet, mobile data speeds kept pace. This was not the case in other countries. According to an Ookla report, China's mobile download speeds saw speed decreases of up to 40 percent during their peak COVID-19 restrictions, while Italy saw decreases of up to 23 percent, and Spain saw decreases up to 15 percent.[1] Over two-thirds of European countries experienced mobile speed decreases of up to 30 percent in late March, according to OpenSignal.[2]

The wireless success story is not accidental. Thanks to the wireless industry's innovation, the nearly $30 billion invested every year by the wireless industry,[3] a timely supply of spectrum due to the leadership of this Subcommittee and the FCC, and a regulatory framework that promotes investment in responsible wireless infrastructure, the U.S. was in a better position than the rest of the world during the pandemic.

The pandemic was only the most dramatic and recent example of the need for reliable and resilient broadband networks. I was honored to be appointed by the Federal Communications Commission as the Vice-Chair of its Broadband Deployment Advisory Committee (BDAC) Disaster Response and Recovery Working Group (DRRWG). Our group delivered a unanimous, consensus report that outlined the challenges and solutions to ensure that reliable, resilient broadband was available before, during, and after natural disasters.[4]

The single greatest legislative opportunity for Congress to enhance the reliability and redundancy of broadband networks is in the transformative infrastructure package now under consideration and proposed in President Biden's American Jobs Plan. That is why one of the most important recommendations of the BDAC's DRRWG was for Congress to make major investments to expand the availability of broadband access. The expert group concluded that resiliency and deployment go hand in hand. The report stated, "the most obvious and immediate means of infusing the necessary capital to address these availability challenges is for Congress to appropriate the additional funds needed to deploy broadband in unserved areas in a timely manner."[5]

The Need for Multiple Technologies to Address Broadband Reliability and Redundancy

Wireless broadband serves as a key lifeline during storms, natural disasters, and other emergencies. Providing that lifeline is the industry's goal every day. Wireless providers and builders have invested significant resources to strengthen and harden networks and improve

[1] *Tracking COVID-19's Impact on Global Internet Performance*, OOKLA, https://www.speedtest.net/insights/blog/tracking-covid-19-impact-global-internet-performance/#/United%20States (last updated July 20, 2020).
[2] Francesco Rizzato, Sam Fenwick, & Ian Fogg, *Mobile Experience During the COVID-19 Pandemic: 4G Download Speed*, OPENSIGNAL (Apr. 08, 2020), https://www.opensignal.com/2020/04/08/mobile-experience-during-the-covid-19-pandemic-4g-download-speed.
[3] *See 2020 Annual Survey Highlights*, CTIA at 3 (Aug. 25, 2020), https://api.ctia.org/wp-content/uploads/2020/08/2020-Annual-Survey-final.pdf (noting industry investment was $29.1 billion in 2019).
[4] *Report and Recommendations: COVID-19 Response*, FED. COMMC'NS COMM'N BROADBAND DEP. ADVIS. COMM. DISASTER RESPONSE & RECOVERY WORKING GRP., (Oct. 29, 2020), https://www.fcc.gov/sites/default/files/bdac-disaster-response-recovery-approved-rec-10292020.pdf [hereinafter *BDAC DRRWG Report*].
[5] *Id*. at 33.

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network resiliency and planning.[6] In 2017, Hurricane Harvey's unprecedented floodwaters affected only 5% of the thousands of wireless facilities in the affected areas of Texas and Louisiana.[7] In the wake of Hurricane Katrina, 1.75 million telecommunications lines were downed while only 1,000 cellular transmission towers were affected.[8] Six months after the storm, 130,000 lines remained out while cellular service was fully operational.[9] After the catastrophic events of 9/11, many point-to-point wireless links were established to supplement the loss of a main switching station housed in the World Trade Center. These links were installed in a matter of days, and many remain as a source of permanent backup.[10]

Once disasters occur, the availability of multiple providers and networks can help consumers and businesses stay connected to critical services and information. Fiber is a state-of-the art network architecture that provides outstanding bandwidth and broadband service and is an essential element of any national broadband buildout effort but comes with its own tradeoffs. WIA members own and operate most of the fiber in the U.S. Regarding its resiliency, like other wireline infrastructure, we are aware that fiber can be vulnerable to damage from natural forces.[11] In rural areas, fiber is usually deployed aerially on utility poles. Aerially deployed networks may be subject to interruptions from environmental events such as wind, ice loading, trees falling, snow and storms, fire, and hurricanes.[12]

Fiber buried underground is still subject to fiber cuts and other disruption often caused by excavations, and while it can be more resilient than aerial, it can also be far more costly, time consuming to deploy and repair, and sometimes impractical depending on the soil and topography.[13] Wireless networks help to ensure that multiple providers and networks are available when disaster strikes. Through overlapping site coverage, diverse deployment of fiber backhaul, and extensive investments in deployable assets, wireless providers can mitigate the impact of disasters on their networks and often restore service more quickly than wireline fiber. As climate change continues to increase the severity of weather events, fiber and other wireline infrastructure will face increased exposure to risk. It is estimated that over 1,000 miles of long-haul fiber conduit and almost 2,500 miles of metro fiber conduit will be underwater by 2032.[14]

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[6] *See 2019 Annual Survey Highlights*, CTIA at 5 (June 20, 2019), https://api.ctia.org/wp-content/uploads/2019/06-/2019-Annual-Survey-Highlights-FINAL.pdf (stating that the wireless industry invested over $253 billion between 2010 and 2019).

[7] Nick Ludlum, *The Wireless Industry Responds to a Historic Hurricane Season*, CTIA (Sept. 26, 2017), https://www.ctia.org/news/the-wireless-industry-responds-to-a-historic-hurricane-season.

[8] Paula Rhea, *Hurricane Katrina: Telecom Infrastructure Impacts, Solutions, and Opportunities*, VERIZONBUSINESS (FEB. 12-16, 2006), https://archive.nanog.org/meetings/nanog36/presentations/rhea.pdf.

[9] *Id.*

[10] Zayan EL Khaled & Hamid Mcheick, *Case Studies of Communications Systems During Harsh Environments: A Review of Approaches, Weaknesses, and Limitations to Improve Quality of Service*, 15 INT'L J. DISTRIB. SENS. NETS. (Feb. 24, 2019), https://doi.org/10.1177%2F1550147719829960.

[11] *See, e.g.*, *The Real Cost of Fiber Cuts: How to solve using Gigabit Wireless*, GIGABIT WIRELESS (Mar. 15, 2016) (noting, among common reasons for outage such as tornadoes and hurricanes, squirrels accounted for 28% of damages to fiber lines in 2010).

[12] *See* THE COMPLETE GUIDE TO FIBER TO THE PREMISES DEPLOYMENT, PPC at 8 (2020), https://www.ppc-online.com/fiber-to-the-premises-ebook.

[13] *See Cost Efficiency infra* pp.15-16 and related discussion.

[14] Ramakrishnan Durairajan et al., *Lights Out: Climate Change Risk to Internet Infrastructure*, In Proceedings of the Applied Networking Research Workshop 2018 (July 16, 2018).

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Unfortunately, these trends are not improving. Extreme heat waves and large storms are predicted to become more common.[15] Wireline infrastructure will continue to face vulnerabilities that are different than wireless options.[16]

Loss of electrical power can create outages of telecommunications service for wired and wireless networks. Telecommunications providers of both fiber and wireless broadband are equally and deeply committed to serving their customers' needs in emergencies. Yet, each is subject – in differing degrees – to the lack of a reliable electric grid. Fiber-to-the-premise (FTTP) networks face the more intractable problem of loss of power to the premise in addition to the network. Most in-home fiber includes a battery backup that lasts twenty-four hours.[17] After those twenty-four hours, services including telephone and 9-1-1 services are lost. Power is often lost in rural areas for weeks even in regularly occurring ice storms and even longer in the wake of disasters. Restoring electrical service to all the homes in the wide areas often affected by these larger natural disasters is a lengthy process. Wireless connectivity requires the difficult, but far less onerous, challenge of providing power only to the transmission site such as a tower to serve all the households in the service area regardless of if they have power on their premises. And consumers can often find alternative locations to re-charge their devices, including in their cars.

Wireless assets, such as cell on wheels ("COWs"), can be quickly rolled in to provide temporary network capacity—including backhaul when a fiber connection is lost— and restore connectivity. This speed of response is simply not always possible in primarily wireline networks that much reach many affected premises. Wireless networks also can be rerouted and optimized during and after a disaster. If one cell site is offline, the network can use capacity from another site to maintain connectivity.[18]

Wireless networks also have unparalleled self-healing capabilities that are being enhanced with 5G technology. Fiber networks in rural areas, particularly aerial fiber that is damaged by storms, tend to take longer to restore. Restoring one tower can quickly provide service to an entire area, versus having to repair numerous fiber breaks or entire areas of poles washed, burned, or blown away. A resilient network is a redundant network. Resiliency is a key factor Congress should consider in prioritizing funding for broadband buildout.

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[15] *See Climate Change Indicators: Weather and Climate*, ENVIRON. PROT. AGEN., https://www.epa.gov/climate-indicators/weather-climate (last visited June 16, 2021).

[16] Anthony Townsend & Mitchell Moss, *Telecommunication Infrastructure in Disasters: Preparing for Crisis Communications*, N.Y.U. CTR. FOR CATASTROPHE PREP. AND RESP. at 8 (April 2005) ("Wireless links, whose links are constructed out of intangible electromagnetic radiation, reduce some of the vulnerability of wired networks"); *see also* David Theodore, *A Climate-Proof Internet is Here and Critical Infrastructure Needs it Yesterday*, CLIMATE RESILIENT INTERNET (Feb. 6, 2020) (suggesting a wireless alternative using point-to-point millimeter wave links as a fail safe for when fiber lines are downed).

[17] *See* Public Notice, *Public Safety and Homeland Security Bureau Reminds Providers of Facilities-Based Residential Voice Services That are Not Line-Powered of Upcoming Requirement to Offer Subscribers 24 Hours of Backup Power for Customer Premises Equipment*, FED. COMMC'NS COMM'N DA 18-1205 (rel. Nov. 27, 2018), https://docs.fcc.gov/public/attachments/DA-18-1205A1.pdf.

[18] *How Wireless Kept Americans Connected During COVID-19*, CTIA at 3 (June 23, 2020), https://api.ctia.org/wp-content/uploads/2020/06/How-Wireless-Kept-Americans-Connected-During-COVID-19-2.pdf.

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Public Safety and First Responders Rely on Mobile Wireless Networks

In terms of disaster response and resiliency, first responders also need universal coverage. First responders rely on wireless broadband as they rush to the front lines for fires, crime scenes, and disasters and need mobile connectivity on site to protect themselves and the public. In many rural areas, the closest hospital can be an hour or more away. Wireless broadband like 5G can turn an ambulance into a mobile emergency room during that "golden hour," saving lives and preventing disabilities.[19]

Many current and potential applications for public safety officials are powered by wireless broadband. A combination of wearables, sensors, cameras, and other Internet-connected technologies are being used by public safety departments to enhance their efforts in a variety of settings. For example, FirstNet, the dedicated network that Congress established to support first responders, has nearly eighty deployable assets available at no cost to subscriber agencies, utilizing Band 14 for best public safety experience.[20] In Chicago and Miami, for example, police departments are utilizing technology that uses an array of smart acoustic sensors to identify gunshots and isolate their location.[21] In Sea Isle City, New Jersey, cameras and sensors are being used to monitor flood risk.[22] Electronic flashing road signs are automatically activated to alert drivers when the flood risk is high.

Unmanned Aerial Vehicles, often referred to as "drones", can get information to first responders faster in an emergency. Drones equipped with cameras are increasingly being used in search and rescue situations to scour areas that may be difficult for people to access. In January 2019, a search and rescue team in Utah used a drone to locate a 60-year-old hiker stranded on a ledge.[23] During the Camp Fire, sixteen Northern California emergency responder agencies worked together using a team of drones to map and track the fire, helping them develop and implement their containment strategies.[24]

Advances in wireless technology have helped spur the development of tools utilized by public safety officials. As next-generation wireless devices and networks roll out across America, 5G

[19] Sanjay Joshi, *5G and Me: And the Golden Hour*, DELL TECHNOLOGIES (Nov. 19, 2019), https://www.delltechnologies.com/en-us/blog/5g-me-and-golden-hour/.
[20] *Understanding the FirstNet Deployable Program: High-impact Solutions for Public Safety Operations*, FIRSTNET AUTH., https://firstnet.gov/system/tdf/Deployables_factsheet_2021.pdf?file=1&type=node&id=1342&force=0.
[21] *Smaller Cities Increasingly Turn to Gunshot Detection Technology to Prevent and Reduce Gun Violence,* INTRADO GLOBE NEWSWIRE (Dec. 22, 2020), https://www.globenewswire.com/en/news-release/2020/12/22/2149702/0/en/Smaller-Cities-Increasingly-Turn-to-Gunshot-Detection-Technology-to-Prevent-and-Reduce-Gun-Violence.html.
[22] *Tech Help With Floods Begins with Sea Isle City Alert System*, PRESS OF ATLANTIC CITY (June 10, 2019), https://pressofatlanticcity.com/opinion/editorials/tech-help-with-floods-begins-with-sea-isle-city-alert-system/article_58d476e4-1feb-5644-a7c8-a91a5bb19e71.html.
[23] Zacc Dukowitz, *Drones in Search and Rescue: 5 Stories Showcasing Ways Search and Rescue Uses Drones to Save Lives*, UAV COACH (Jan. 18, 2019), https://uavcoach.com/search-and-rescue-drones/.
[24] Joe Rosato Jr., *How a Squadron of Drones Mapped the Entire Paradise Camp Fire Zone in Two Days*¸ NBC BAY AREA, https://www.nbcbayarea.com/news/local/how-a-squadron-of-drones-mapped-the-entire-paradise-camp-fire-zone-in-two-days/201896/ (last updated Nov. 29, 2018).

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will enable a whole new generation of public safety innovations. Public safety and disaster response is another key factor Congress should prioritize for funding broadband infrastructure.

Wireless Networks are Vital to Addressing Climate Change

Reliable and redundant telecommunications networks have the unique ability to help prevent and to mitigate the destruction of disasters before they occur, as well as providing the means to respond to them. Scientific reports indicate that climate change is a major factor spurring the increasing number and severity of natural disasters – and one that humans can address.[25] Studies have shown how dramatically the latest advances in broadband, wireless broadband, and particularly 5G networks, can help reduce greenhouse gas emissions. The Global e-Sustainability Initiative documented that Internet-enabled solutions could reduce greenhouse gas emissions by 16.5%.[26]

The characteristics of wireless networks' wide area coverage, mobility, and speed of deployment offer unique benefits that address every policy goal of President Biden's American Jobs Plan. In fact, every element of the President's plan will rely on rapid deployment of wireless connectivity, including energy and smart grid, transportation and connected cars, agriculture, water and land use, building efficiency, and advanced manufacturing. The World Economic Forum documents that the digital technology sector, relying on 5G connectivity, "is probably the world's most powerful influencer to accelerate action to stabilize global temperatures well below 2°C."[27] Indeed, "digital technologies could already help reduce global carbon emissions by up to 15% – or one-third of the 50% reduction required by 2030."[28]

To ensure that federal broadband infrastructure investments effectively target climate change, Congress should keep in mind the most important applications that accomplish the goal. Each of the most fundamental green technologies enabled by broadband requires wide-area and ideally universal and mobile coverage of rural America. These include smart grid, smart transportation and autonomous vehicles, precision agriculture, and water conservation.

Wireless networks provide additional benefits to emerging technologies that will rely on resilient networks. Smart transportation, such as self-driving and electric vehicles, rely on advanced mobile networks to provide instantaneous connectivity for numerous operations, especially safety sensors. Vehicle traffic congestion is a major source of emissions. It is estimated that

[25] *See, e.g.*, *Climate Change Indicators: Weather and Climate*, ENVTL. PROT. AGEN., https://www.epa.gov/climate-indicators/weather-climate (last visited June 16, 2021) (noting heat weaves and large storms are likely to become more frequent); *The Effects of Climate Change*, NAT'L AERO. AND SPACE ADMIN., https://climate.nasa.gov/effects/ (last visited June 17, 2021) ("Effects that scientists had predicted in the past would result from global climate change are now occurring: loss of sea ice, accelerated sea level rise and longer, more intense heat waves.").

[26] *GeSI Smarter 2020: The Role of ICT in Driving a Sustainable Future*, GLOBAL E-SUSTAINABILITY INITIATIVE AND BOSTON CONS. GRP. at 9 (Dec. 2012), https://www.telenor.com/wp-content/uploads/2014/04/SMARTer-2020-The-Role-of-ICT-in-Driving-a-Sustainable-Future-December-2012._2.pdf.

[27] Börje Ekholm & Johan Rockström, *Digital technology can cut global emissions by 15%. Here's how*, WORLD ECON. FORUM (Jan. 15, 2019), https://www.weforum.org/agenda/2019/01/why-digitalization-is-the-key-to-exponential-climate-action/.

[28] *Id*. (emphasis added).

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cars are responsible for about 30% of CO2 emissions.[29] Deloitte estimates that self-driving cars, which rely on wireless connectivity, could reduce emissions by 40 percent to 90 percent, cut travel times by nearly 40 percent, and reduce delays by 20%.[30] In addition, smart city and smart building technologies could result in $20 billion in savings if the energy efficiency of buildings is increased by just 10%.[31]

5G networks will increase manufacturing efficiency and sustainability goals. 5G can enable more efficient compressors that waste less energy, increase boiler efficiency to reduce air waste energy, and improve motor voltage imbalances to reduce energy consumption.[32] Furthermore, 5G will reduce greenhouse gas emissions in numerous ways, such as making smarter electric grids that are more efficient and resilient.[33]

For example, WIA member Anterix is working with utilities to deploy utility-grade private networks, providing capabilities, features, functions, and equipment for reliable and resilient connections for essential services. These new networks enable a range of new use cases, such as the Falling Conductor Protection capability developed by San Diego Gas & Electric and Schweitzer Engineering Laboratories. It relies on the low latency of LTE – the same technology used in our phones – to enable broken power lines to be de-powered in the interval between breakage and hitting the ground, which reduces their likelihood to ignite wildfires that have recently plagued so much of the country and contributed to global warming. [34]

Internet of Things ("IoT") technologies in appliances, buildings, factories, and homes employ sensors that rely on 5G as they monitor and analyze energy usage. These technologies alone could cut carbon emissions 15% by 2030.[35] Smart energy grids also employ 5G. The Pacific Northwest National Laboratory found that it could directly reduce energy usage and carbon impact by 12% and indirectly by 6%.[36] Having resilient electrical grids has become increasingly important during destructive wildfire seasons. As electrical grid operators aim to enhance their networks for greater reliability and resiliency, sensors and analytics enabled by 5G applications

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[29] *Digital Transformation of Industries: Automotive Industry*, WORLD ECON. FORUM at 4 (Jan. 2016), https://reports.weforum.org/digital-transformation/wp-content/blogs.dir/94/mp/files/pages/files/wef-dti-automotivewhitepaper-final-january-2016.v1.pdf.

[30] *Wireless Connectivity Fuels Industry Growth and Innovation in Energy, Health, Public Safety, and Transportation*, CTIA (Jan. 19, 2017), https://www.ctia.org/news/deloitte-wireless-connectivity-fuels-industry-growth-and-innovation.

[31] Darrell M. West, *Achieving Sustainability in a 5G World*, BROOKINGS at 4 (Dec. 2016), https://www.brookings.edu/wp-content/uploads/2016/11/gs_20161201_smartcities_paper.pdf.

[32] *See generally id*. (describing ways that 5G technology will enable resource management and sustainability).

[33] *See, e.g.*, Sofana Reka ET AL., FUTURE GENERATION 5G WIRELESS NETWORKS FOR SMART GRID: A COMPREHENSIVE REVIEW, 12 ENERGIES 2140 at 2145 - 49(June 4, 2019) (detailing several benefits 5G will provide to electrical systems including real time demand response).

[34] *Wildfire Safety Innovation: Cutting off Power to a Broken Power Line Before it Hits the Ground!*, SAN DIEGO GAS AND ENERGY (Mar. 20, 2019), https://sdgenews.com/article/wildfire-safety-innovation-cutting-power-broken-power-line-it-hits-ground.

[35] Renee Cho, *The Coming 5G Revolution: How Will it Affect the Environment?*, COLUM. CLIMATE SCHOOL (Aug. 13, 2020), https://news.climate.columbia.edu/2020/08/13/coming-5g-revolution-will-affect-environment/.

[36] R. Pratt, ET AL., *The Smart Grid: An Estimation of the Energy and CO2 Benefits*, PACIFIC NW. NAT'L LAB. (Jan. 2010); *see also* Bruce Weindelt, *Digital Transformation of Industries: Automotive Industry*, WORLD ECON. FORUM at 4 (Jan. 2016).

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are increasingly critical, "allowing for timely diagnosis, prediction, and prescription of all system variables and assets during normal and extreme-event conditions."[37]

Water conservation and efficient farming is another benefit of wireless broadband. Agriculture accounts for 80% of water use in the U.S.[38] Agricultural IoT technologies, like precision agriculture, monitors, soil property and yield mapping, and satellite imagery, can help to reduce agricultural water consumption by as much as 15% per year.[39]

For the telecommunications industry itself, 5G networks are estimated to be 40% more energy efficient due to technological evolution, which has dramatically increased energy efficiency, particularly in chipsets.[40] 5G processors and radios are tightly designed together, which promotes smart, integrated, energy saving features.

There is much debate in Congress today about the level of resources the infrastructure plan should dedicate to combatting climate change. Yet, there seems to be wide agreement on the need for broadband deployment funding. Congress should target resources to deploy broadband infrastructure to maximize the beneficial impact on climate change. No broadband technology is better documented to achieve climate change goals than wireless broadband. If even a fraction of the 15% reduction in carbon emissions estimated by WEF is achieved, it would be a monumental contribution toward saving the planet. Excluding wireless broadband would miss an urgently needed opportunity to combat global warming and to prevent untold disasters from occurring in our lifetimes and those of generations to come.

Lessons from the Recovery Act and then Vice-President Biden: The Need for Flexibility

My experience overseeing the Broadband Initiatives Program as Administrator of the Rural Utilities Service at the Department of Agriculture ("USDA") for the Obama-Biden Administration can provide useful lessons as this Committee deliberates on how best to accomplish its broadband deployment objectives. It turns out that this can be much more complicated in practice than it might appear.

I am very familiar with financing FTTP projects: the RUS under the Recovery Act ultimately approved 221 fiber wireline projects, 60 wireless projects and 28 combined wireless/wireline.[41] Given the severity of the economic downturn, we strove to move as quickly as possible seeking "shovel ready projects." These were fewer and farther between than hoped. I was confirmed by the U.S. Senate in June 2009 after the policy was already established for the first round Notice of Funding Availability (NOFA). Of the roughly $3.5 billion ultimately awarded, the first round awarded $1.067 billion for 68 broadband projects.

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[37] Louis Brasington, *Digital Smart Grid Resilience: Wildfire Mitigation and Reliability*, CLEANTECH GRP. (Oct. 22, 2020), https://www.cleantech.com/digital-smart-grid-resilience-wildfire-mitigation-and-reliability/.
[38] Darrell M. West, *Achieving Sustainability in a 5G World*, BROOKINGS at 2 (Dec. 2016), https://www.brookings.edu/wp-content/uploads/2016/11/gs_20161201_smartcities_paper.pdf.
[39] E.J. Sadler et al., OPPORTUNITIES FOR CONSERVATION WITH PRECISION IRRIGATION, 60 J. OF SOIL AND WATER CONSERV. 374, 377 (Oct. 27. 2015).
[40] *GeSI Smarter 2020: The Role of ICT in Driving a Sustainable Future, supra note 7* at 209.
[41] DISTRIBUTION OF BROADBAND STIMULUS GRANTS AND LOANS, CONG. RESEARCH SERV. at 6 (January 4, 2011).

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However, funding was going out the door more slowly than the White House wanted to see. As we were devising the rules for the second and final NOFA, I was first called into the office of Chief of Staff Rahm Emmanuel, who admonished RUS to speed up the process. Shortly thereafter, I was called into the office of then-Vice President Biden, who had been charged by President Obama with overseeing the Recovery Act. Needless to say, this second meeting was more pleasant.

The guidance Vice President Biden shared was as clear as it was sound: "Give yourselves more freaking flexibility." I will never forget those words – which is a direct quote, not a PG-rated version – because they became our motto as we made policy cuts in the second NOFA. When deliberating on decisions, I often called for more "freaking flexibility."

Vice President Biden's advice proved as wise as it was piquant. We made major changes in the second NOFA, including the mix of grants and loans, that were critical to the success of the program.[42] It is a heretofore unreported fact that RUS had almost more funding than it had qualified projects. RUS received $28.965 billion in total applications for grants and loans that resulted in $3.529 billion RUS ultimately awarded. Yet, in the final process, almost every award that passed both our financial feasibility and our technical feasibility screens won funding – with only a handful that could have met those screens left at the end of the process. In other words, only about one in eight projects penciled out as technically and financially feasible.

The lesson of the Recovery Act is that Congress cannot assume that if it provides funding with narrow strictures that its vision can be achieved – even if funding levels are very large as to appear sufficient. From the perspective of an Administrator, the agency does not choose who applies and which private or municipal actors are willing to step up. The agencies to which Congress allocates funding can only rely upon and consider what comes in through their doors. Agencies are limited to those operators that are prepared to offer the service specified. Even more fundamentally, implementing agencies can and should only fund those operators among them – whether for-profit, non-profit or municipal – that are not only willing, but able to demonstrate a plan that is both financially and technically feasible. The way telecommunications networks are structured geographically, typically only providers already serving an area or with existing infrastructure in the region are interested in or capable of expanding to the most hard-to-reach areas.

Clearly, we learned that finding feasible projects is difficult. The more rural and less densely populated the area, the more difficult it becomes. The essential limiting factor is often whether – even if Congress pays for 100% of the capital expenses – the ongoing revenues from end users cover the operating expenses. Again, the less densely populated the service area (those Congress most seeks to reach) the more difficult this long-term business case becomes.

I am concerned that if Congress does not provide implementing agencies with needed flexibility, it will find that for many areas, no qualified applications will come in the door and areas will

[42] MARK A. ABRAMSON AND PAUL R. LAWRENCE, PATHS TO MAKING A DIFFERENCE, LEADING IN GOVERNMENT ch. 4 (revised ed. 2012).

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remain unserved. Worse, if financially infeasible projects are nevertheless approved, the networks will be unsustainable, and consumers will lose the quality of service or end up having no service at all. For example, as noted above, fiber cuts in areas with long fiber runs (such as through rural, wooded areas) are expensive to repair, particularly considering that few customers are providing the revenue to cover those costs. If overly prescriptive technological parameters are sealed in statute, it may be too late to for Congress to change course, as we did at RUS in the second NOFA.

The lesson is that applications are very provider specific and geographically specific. The unique history of network investment in a particular service area dictates feasibility along with the financial and technical strength of the operator proposing to provide service. Two areas similar in geography and density may not have similarly strong providers or existing networks from which to extend further into rural areas. For example, there may be an area in West Virginia that is similarly rugged and sparsely populated to one in Montana. However, one might have a local cooperative that has long invested in building out fiber connectivity, with a solid balance sheet girded by years of RUS and Universal Service funding, while the other has not benefited from similar investments in infrastructure or have a similarly strong local provider. One might offer a feasible project proposal while the other does not -- or one area may not even get a qualified application to serve it. If Congress does not provide the funding agencies flexibility to take in the door a wider variety of proposals, one area may go unserved – or worse, become unserved when the provider is unable to cover its costs due to limited ongoing customer revenues after it is built at taxpayer expense.

Solution: Congress Establishes Priority Goals, not Limiting Technology Decisions about How to Achieve Them

Congress should set funding agencies' goals and not set technological gating factors. Otherwise, Congress may tie funding agencies down with limited flexibility to even consider innovative, cost-effective, and geographically appropriate provider applications that would have likely met Congressional priorities or have met them sooner.

In the history of this distinguished Committee, the Communications Act is a model of setting goals and priorities rather than specific technological solutions that may or may not be sustainable or even meet all of Congress's objectives.

Rather than cementing specific broadband speeds in statute, Congress can set a checklist of priority factors, including the following based on Congressional and Administration priorities:

- Resiliency of networks: both vulnerabilities and the speed of restoration;
- Higher broadbands speeds;
- Mobility, highly valued by consumers in rural and other areas, which is also an added benefit of fixed wireless broadband investment;
- Speed of deployment and infrastructure siting;
- Public safety: the needs of first responders and emergency response;
- Contribution to reducing carbon emissions and thus preventing future natural disasters;
- Target unserved areas;

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- Affordability to consumers;
- Cost efficiency;
- Workforce development.

Congress has long expressed the value of each of these factors and should not choose one at the expense of all others, which would happen if certain priorities were locked in as gating factors that preclude the consideration of other factors. Consider each in turn:

Resiliency: As indicated by this hearing, the resiliency of telecommunications networks is a priority for the Committee. American lives and property depend upon it, as we have seen in the pandemic. All telecommunications technologies, including wireless broadband, have their own vulnerabilities. As noted above, for obvious reasons, long stretches of aerially deployed fiber optic cable, or for that matter any wireline service deployed overhead, are exposed to many natural forces, and can take long periods to restore. Moreover, FTTH is dependent on electrical service at the home, which is often disrupted for long stretches. Whether one agrees with this analysis or not, Congress should not tie agencies' hands to one technology that may be more exposed to risk. It can charge funding agencies with considering resiliency as a factor in "future-proofing" funding choices. Agencies can ask applicants to identify the level of resiliency for its proposed broadband delivery mechanism – and make them prove their capability to meet their promises, both technically and financially. They can ask: how vulnerable is your technology to outages? What steps are you taking to ensure resiliency? How long will it take to restore service and what will it cost? Is your network financially sustainable considering those costs and the likelihood of disruptions in the proposed service territory?

Resilient networks mean sustainable networks. Real "future proofing" requires that the companies that are provided funding to build networks will remain in business to provide service to customers into the future. Resiliency is key because ongoing operating costs must be covered by the revenue stream, or the networks will fall into disrepair and will not remain open consistently, provide adequate customer service or quick outage restoration, or could become inoperable.

Higher speeds: Members of Congress have expressed an interest in prioritizing symmetrical speeds. Consumers clearly separately value both download and upload speeds, and it makes sense for agencies to prioritize them independently. The gap between downstream and upstream traffic has consistently grown over the last ten years. Recently, the ratio of downstream consumption to upstream is fourteen to one.[43] Current consumer trends demonstrate significant

[43] *See* John Ulm & Tom Cloonan, *The Broadband Network Evolution Continues*, COMMSCOPE 9 (2019), https://www.nctatechnicalpapers.com/Paper/2019/2019-the-broadband-network-evolution-continues; *see also The Asymmetric Nature of Internet Traffic*, NCTA (Mar. 22, 2021), https://www.ncta.com/whats-new/the-asymmetric-nature-of-internet-traffic (stating that the downstream to upstream traffic ration was sixteen to one at the end of 2020. *But see, e.g.*, Peter Rysavy, *The Folly of Attempting to Future-Proof Broadband*, LIGHT READING (June 15, 2021), https://www.lightreading.com/opticalip/the-folly-of-attempting-to-future-proof-broadband/a/d-id/770204 (noting a reverse in the trend that the gap between downstream and upstream grows every year due to increased use of video learning, telemedicine, and telelearning bringing the ratio down to ten to one).

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increases in downstream consumption while upstream increases at a fraction of the rate.[44] Today's consumers do not utilize upstream bandwidth at the same rate they use downstream and speak to it with their dollars and usage. Video streaming makes up over 80 percent of all Internet traffic, two thirds of which is traffic from downloads.[45] Even popular applications that utilize relatively high upload bandwidth, such as two-way video conferencing, do not require anything near symmetrical speeds. Studies have shown video conferencing requires approximately one third of the upstream bandwidth compared to downstream.[46]

Networks are optimized based on consumer use patterns. The telecommunications industry has responded by engineering networks to favor downloads to meet their customers' demand. It is possible that consumers will reverse long-term trends favoring download speeds; however, even if upload speeds demand doubles, it will remain far below download speed demand. The speculative prediction that upload speed demand will dramatically rise can justify making it a priority, but it is not a good basis to make symmetrical speeds the sole eligibility requirement for an entire planned investment of this magnitude – to the exclusion of other priorities.

To make symmetrical upload the primary gating criterion for funding would shortchange addressing resiliency, climate change and disaster prevention, the speed of getting service to rural Americans, mobility, public safety, affordability and other key factors we know consumers value now and urgent crises Congress seeks to address.

Mobility: We know for certain that Americans value mobility. Rural Americans traverse longer distances and rely on mobility even more heavily. If wireless technology to serve fixed or in-home or mobile broadband is excluded from an infrastructure plan, Congress could inadvertently grow a rural mobility digital divide in which many unserved residents would be limited to accessing the Internet through a wired connection in the home or farmhouse. All broadband technologies, including wireless broadband, are needed to provide communities with robust connectivity. And if Congress gives wireless broadband technology a fair chance to compete for the same funding, including for the in-home market, consumers will benefit from mobility that is provided by all wireless broadband investments including fixed wireless that supports 5G.

This rural mobility divide would preclude rural Americans from access to similar interconnected solutions that are available to their urban counterparts. Rural residents should not be tethered to the relatively short leash of ethernet or a Wi-Fi signal when they need a high-speed connection. Further, many applications, such as precision agriculture, require wireless broadband to blanket vast acres of farmland to be useful. The larger properties and distance between houses that many

[44] *See id*. at fig. 3, 4 (demonstrating a 37.8% average growth rate over five years for downstream while upstream has a 18.8% growth rate for the same time).
[45] *The Global Internet Phenomena Report*, SANDVINE at 6 (Sept. 2019), https://www.sandvine.com/hubfs/Sandvine_Redesign_2019/Downloads/Internet%20Phenomena/Internet%20Phenomena%20Report%20Q32019%2020190910.pdf; *see also Distribution of Global Downstream Internet Traffic as of October 2018, By Category*, STATISTA (Feb 13, 2018), https://www.statista.com/statistics/271735/internet-traffic-share-by-category-worldwide/.
[46] Jay Zhu ET AL., *Testing Bandwidth Usage of Popular Video Conferencing Applications*, CABLE LABS (Nov. 5, 2020), https://www.cablelabs.com/testing-bandwidth-usage-of-popular-video-conferencing-applications (studying various video conferencing applications utilization of upstream and downstream bandwidth).

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Americans seek out by living in rural areas require larger areas of service. For children doing homework on hour-long bus rides in rural areas, for example, waiting until they get back home to go online is not a good option. In terms of a priority, you might ask your rural constituents what they value more: greater broadband mobility on the road and across their farm fields -- or upload speeds at home. For those like me who have lived in rural America, I expect you can guess the answer.

Speed of deployment, infrastructure siting and workforce needs: Fiber can take months to years to deploy even in easy geography, but more complex deployments can take many years. Wireless broadband links can be installed and ready for operation in a matter of days in a variety of scenarios.[47] According to a study by the Fiber Broadband Association, it would take 10 years and an additional $70 billion to pass 90% of U.S. households – before even reaching the last 10% which are of greatest concern for rural access.[48] To connect that 90% would require an additional $15 billion.[49]

Given rural consumers urgent need for broadband, especially in rural and unserved areas, the focus should be on utilizing all technologies to connect all communities as quickly as possible. And wireless broadband can be deployed quickly. WIA members report that, on average, it can take about six months for a wireless collocation and about eighteen months for a new tower to be built.

Future proof should not mean deployed far in the future. Rural consumers should not have to wait in the back of a long line for many years to finally get the broadband Congress promised. Connectivity delayed is connectivity denied. Speed to market should be a priority Congress charges funding agencies to consider. In terms of keeping up with consumer needs – real future proofing – wireless networks are upgraded constantly. 5G is the most readily upgradeable generation of wireless broadband. Once deployed, it is easier to upgrade networks to handle varying demands and ultimately to upgrade to the next generation of wireless broadband. To achieve Congressional goals, placing a priority on getting networks up and running will meet rural Americans' urgent needs. Speeding deployment will require working to encourage providers to offer plans customized to different communities -- not one-size-fits all. Congress should provide priority and flexibility for expert funding agencies to evaluate how quickly providers can deliver.

Public safety and first responders: As noted above, first responders rely on mobile networks as they go in harm's way to protect the public. Fiber to the premise will not help them as they race to put out fires, deliver health care in ambulances that can become a mobile emergency room with 5G, or protect the public from crimes in progress. Public safety has always and will always rely on mobile networks. Service to those who serve us should be a priority goal established by Congress for funding agencies.

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[47] Dori Erann, *Fiber VS Wireless- The Greatest Debate of the Decade*, CERAGON (Mar. 18, 2021), https://www.ceragon.com/blog/fiber-vs-wireless-the-greatest-debate-of-the-decade.
[48] *FTTH Study 2019*, CARTESIAN at 2 (June 4, 2019), https://optics.fiberbroadband.org/Portals/0/Cartesian%202019%20FTTH%20Study%20Summary%20Findings%20190604%20SENT.pdf at 2.
[49] *Id*. at 4.

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Battling climate change: As noted above, broadband and digital technologies can contribute to solving the crisis of climate change. Wireless broadband and 5G solutions play a particularly strong role given the need for wide-area coverage, mobility and distributed IoT applications. Congress can set as a priority factor that funding agencies consider the degree to which the proposed project will contribute to the reduction of carbon emissions. Again, if only wireline technology can be considered, Congress could tie agencies' hands in terms of considering the full range of options to achieve this clear priority. Let the best technology win.

Target unserved areas: Congress should target funds to truly unserved areas as defined by the FCC as lacking broadband service. To close the broadband gap, define "unserved" as those locations lacking service delivered through either wired or wireless technology. Accurate broadband maps are needed that take into consideration areas with already committed build plans so that support is targeted where it is needed.

Congress can also reduce barriers to deployment by creating incentives for local jurisdictions who are able to demonstrate 5G and broadband readiness through siting-friendly rules such as the adoption of efficient, simplified processes, and cost-based access to the right of way. WIA supports a priority for funding to communities that demonstrate 5G and broadband readiness by implementing streamlined and cost-based access to the rights-of-way. Importantly, Congress can maximize the value of broadband investments, address concerns of city leaders about aesthetics and disruption to communities, reduce environmental impact, and speed deployment by prioritizing the use of existing infrastructure. Policies, like those Congress approved in Sec. 6409 of the Middle Class Tax Relief and Job Creation Act of 2012 to prioritize the use of existing infrastructure, and dig once policies that are widely supported for fiber deployment, are prime examples. This ensures that networks can be deployed expeditiously while recipients are held accountable for outcomes.

Affordability: As the technological capabilities of mobile devices continue to grow to rival traditional computers, many users have decided to prioritize their mobile connections over fixed.[50] This choice is most clear among rural and low-income Americans, the majority of individuals who identify as "smartphone only users."[51] In rural America, nearly one in five residents has decided to rely solely on their wireless devices for broadband, while over one in four Americans who make less than thirty thousand dollars a year have made the switch to smartphone only; the same is true for those that have a high school degree or less.[52] All of these groups, and all Americans, would benefit from an upgrade to 5G to support their choice. If FTTH is the only choice, millions of rural Americans would need to spend an additional $75 a month, or more, for a wireline connection that they already decided they do not want or cannot

[50] Monica Anderson, *Mobile Technology and Home Broadband 2019*, PEW RESEARCH CTR. (June 13, 2019), https://www.pewresearch.org/internet/2019/06/13/mobile-technology-and-home-broadband-2019/ (stating 45% of non-broadband users said they do not have a connection at home because their smartphone meets all of their online needs).
[51] Andrew Perrin, *Mobile Technology and Home Broadband 2021*, PEW RESEARCH CTR. (June 3, 2021), https://www.pewresearch.org/internet/2021/06/03/mobile-technology-and-home-broadband-2021/ (providing a demographic breakdown of smartphone only users).
[52] *Id*.

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afford.

Congress should build on steps it has taken in the Consolidated Appropriations Act of 2021 that established an Emergency Broadband Connectivity Fund of $3.2 billion to help Americans afford Internet service during the pandemic. It should fund a permanent affordability support program with sufficient subsidies to ensure low-income families obtain quality broadband. Saddling consumers with the need to purchase a new wireline service on top of their smartphone connection could unnecessarily add to the burden of large ongoing federal subsidies because few low-income consumers are willing to give up their smartphone and the mobility it provides.

Cost efficiency: Technological flexibility can also provide consumers with the most megabits for the taxpayer dollar. The wireless industry is committed to closing the digital divide and has an indispensable role to play. Fiber is critical, yet it is one of many tools for closing the digital divide. The last mile – or last 10 miles in some cases in rural America – is most costly to provide with fiber, when simply connecting fiber to a tower for mobile or fixed wireless can cover many premises for a fraction of the cost and in a much shorter time. To provide connectivity to all communities, every broadband technology can contribute based on a community's specific needs and the capabilities of existing providers.

Wireless broadband is an economically efficient solution that must be considered as part of the plan. When considering barriers to deployment, including the capital expenditure required to reach each new subscriber, time to market, and physical limitations of deploying infrastructure across diverse terrains, wireless service that covers long distances in some cases makes more sense than a home-by-home approach.

Underground fiber deployments must consider a myriad of factors to ensure the longevity of the deployment, all of which add to cost and time for completion of a project. In coastal cities and areas prone to flooding, deployments must work around the water table often digging deeper to avoid water damage. In some of our hardiest states, including Alaska, Minnesota, Wisconsin, and the Dakotas, frost lines can require deployments to bury conduit six feet underground or deeper.[53] Soil and buried obstacles also play a role in determining speed and cost. For example, clay is harder to excavate than other soils and may contain rocky particles that can impinge on conduit, requiring additional hardening.[54] Unexpected tree roots and boulders are also sources of significant delays.[55] While insulated from some weather patterns and physical disruption, underground deployments are simply not technologically or economically feasible in all situations.

Workforce development: Another source of broadband deployment delay is the lack of a sufficient skilled workforce. To help ensure a diverse pipeline of job-ready workers ready for

[53] *Frost Line by State 2021*, WORLD POPULATION REVIEW, https://worldpopulationreview.com/state-rankings/frost-lines-by-state (last visited June 17, 2021).
[54] *The Complete Guide to Fiber to the Premises Deployment*, PPC at 8 (2020), https://www.ppc-online.com/fiber-to-the-premises-ebook.
[55] *See* Joe Byrne, *Key Factors When Choosing Between Buried and Aerial Fiber Deployments*, PPC https://www.ppc-online.com/blog/key-factors-when-choosing-between-buried-and-aerial-fiber-deployments (last visited June 17, 2021).

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these jobs, Congress should take bold action to invest in registered apprenticeships and evidence-based job training and support.

Today, registered apprenticeship in the broadband industry is new and would quickly need resources to scale to the level needed to support the level of funding contemplated by Congress and the Biden Administration. To solve this "good problem" from creating high-wage, high-skilled jobs, and to increase the efficiency, equity, and success of a broadband infrastructure investment, a corresponding initiative is needed to develop and diversify the broadband workforce through additional support for registered apprenticeships and the educational and training system. An immediate expansion of education and skills training will create a pipeline for broadband infrastructure jobs in a growing industry of the future.

Conclusion

Every community, regardless of size, location, or geography deserves broadband service. Congress has an extraordinary opportunity to expand digital inclusion and take dramatic steps to bridge the digital divide. Industry and the government must step up to meet this moment. This is no small task and will take every tool available. We must ensure the rapid deployment of networks that can meet consumer demands. We must ensure that these networks work in all scenarios from natural disasters to pandemics.

While no technology alone will meet all these needs, wireless broadband is a key component of a resilient broadband network. With its distributed architecture, wireless broadband is inherently resistant to disruption; if one node goes down, traffic is rerouted to nearby antennas. Further, during times of disaster, we turn to wireless assets to help supplement telecommunications and broadband services, keeping people informed, allowing them to contact emergency services, and allowing first responders to coordinate efforts. Beyond today, wireless technology, particularly 5G, will allow for revolutionary, and life-saving applications in disaster preparedness and response. These applications will directly contribute to U.S. commitments to mitigate climate change through increasing energy efficiency and will mitigate the frequency and severity of future disasters. Deploying this technology will also create millions of jobs across the country, many of which will not require a college degree. These jobs will elevate individuals as they build their own communities, providing opportunities and services that will benefit everyone. Congress can maximize this potential with support for registered apprenticeships and training for the telecommunications workforce.

Realizing these benefits and bridging the digital divide will take continued, dedicated efforts by the entire telecommunications industry and the federal government. WIA and its members stand ready to deliver.

Wireless broadband helps to drive America's innovation economy and fuels the nation's economic future. The U.S. has always been the global leader in wireless innovation. Broadband infrastructure legislation offers a unique opportunity to increase network resiliency if Congress designs the program with sufficient flexibility to address it and other Congressional priorities such as combatting climate change.

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That is why the leadership of this Subcommittee is so critical. WIA appreciates the opportunity to partner with the Subcommittee in addressing these important issues. We are deeply grateful for the bipartisan recognition of the importance of infrastructure by this Subcommittee, by Congress, by the FCC, and the Biden Administration. All have implemented policies to promote wireless broadband deployment, and all are working to build on recent successes.

Thank you again, Chairman Lujan and Ranking Member Thune, for holding this hearing and inviting me to testify. I look forward to continuing to work with you and the rest of the Subcommittee to make real progress on these very important issues.

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