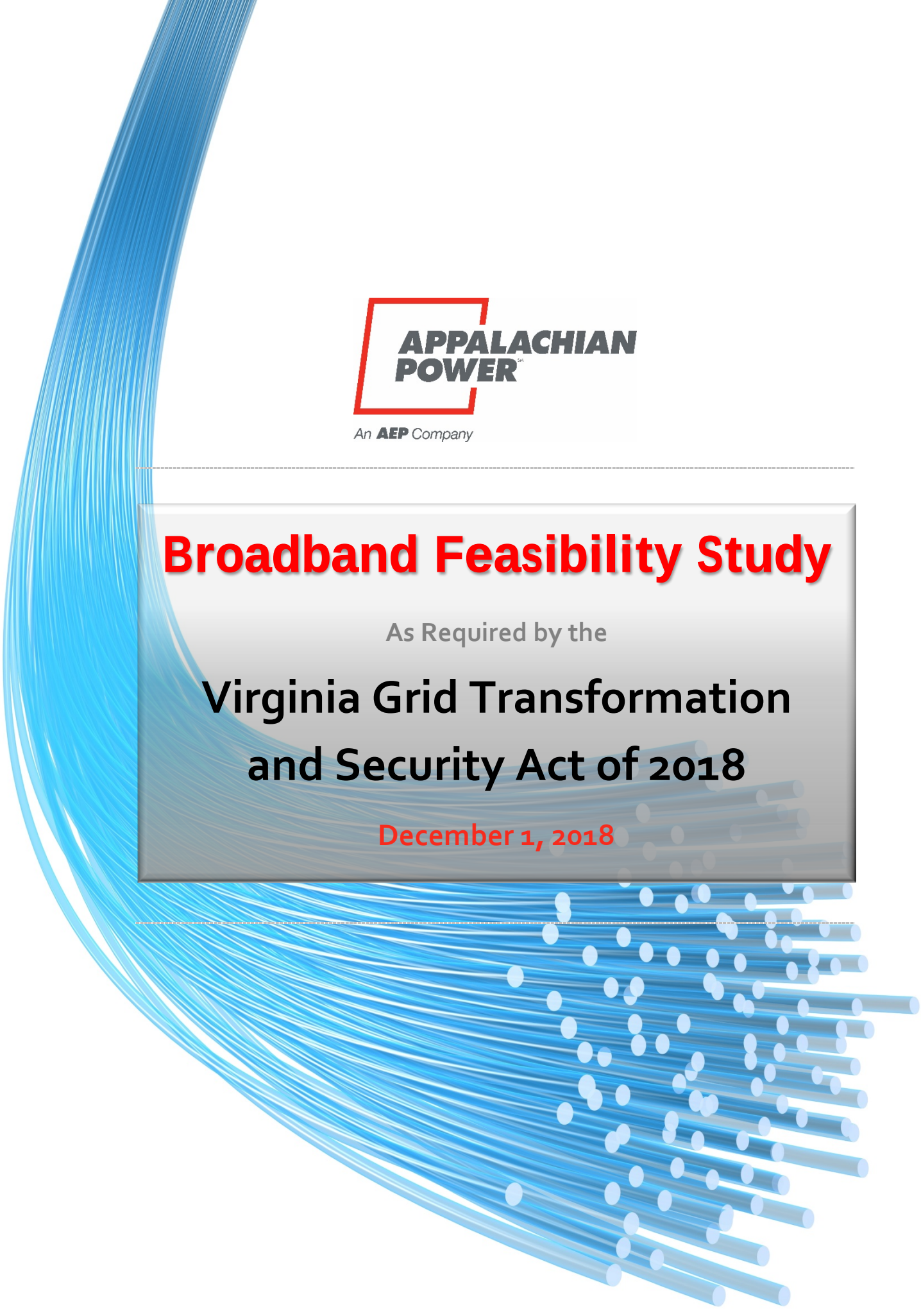

Broadband Feasibility Study

As Required by the

Virginia Grid Transformation and Security Act of 2018

December 1, 2018

Contents

Executive Summary

"Broadband networks are the first enabling technology since electricity to fundamentally impact society to such a great extent that it is now viewed in economic development circles as critical infrastructure. Access to broadband provides communities with the foundation necessary for economic growth and a sustainable quality of life."[1] The opportunities afforded by such access are limited or non-existent in many regions of Virginia, especially rural areas with low densities of population. Expanding broadband access to under and unserved areas will require a portfolio of solutions and resources.[2] Electric utilities are uniquely positioned to play a key part in this expansion, if efforts to deploy broadband infrastructure, in particular, the middle-mile fiber backbone needed by last-mile installers and service providers, can be coordinated and accomplished in parallel with electric grid modernization programs. Recognizing that electric utilities may have an important role in supporting broadband expansion, the General Assembly passed the Grid Transformation and Security Act ("Act") in 2018, which required Appalachian Power Company ("APCo") to "investigate the feasibility of providing broadband Internet services using utility distribution and transmission infrastructure."

APCo defined working assumptions as a foundation for potential strategies to support broadband expansion, including the following:

- APCo will focus solely on the development and ownership of middle-mile fiber and will not develop last-mile infrastructure.
- APCo will not compete with broadband providers to directly serve customers.
- Any strategy must align with APCo grid modernization projects that include fiber.
- APCo must reserve a portion of any new middle-mile fiber for internal use.
- APCo must be able to recover costs from its electric service customers, including but not limited to operations and maintenance costs and a reasonable return on and of investments associated with middle-mile assets through a rate adjustment clause. All lease revenue would, in turn, be credited to electric service customers.
- APCo will not seek grants or government funding for middle-mile development.

Potential APCo strategies to support broadband development involve increasing the capacity of fiber that APCo would install to support its grid modernization programs for the collateral benefit of middle-mile expansion. For currently planned projects, the strategy would increase the amount of individual fiber strands installed so that the added capacity could be leased as a

1 Virginia Office of Telework Promotion and Broadband Assistance.
www.wired.virginia.gov/content/basics
2 For purposes of this study, "broadband" refers to the current FCC definition of 25 Mbps upload and 3 Mbps download.
www.fcc.gov/reports-research/reports/broadband-progress-reports/2018-broadband-deployment-report

middle-mile asset. Prospective projects in the future could be designed specifically to install fiber optic cable for the dual purpose of grid modernization and middle-mile development.

The Act requires these potential strategies to be evaluated with respect to their technical, execution, financial, and regulatory feasibility. Results of the evaluation were used to develop the following responses to the inquiries requested by the Act:

Is it feasible to provide broadband services using distribution and transmission infrastructure?

Possibly, but real barriers were identified. It is technically feasible to provide broadband infrastructure using electric utility assets. It is also feasible for electric utilities to execute a strategy that can bring middle-mile infrastructure to underserved and unserved regions by the efficient utilization of current and prospective grid modernization programs. Execution of these strategies through the electric utility installing fiber within the power zone of poles provides for increased efficiencies in terms of the timing and cost of deployment. Proper due diligence during the planning and design phase could add cost and time to projects if new easements must be obtained. Financially, it is cost effective to add capacity to existing fiber deployments that are part of grid modernization programs. Plus, the co-benefits of broadband can make it more cost effective to extend the reach of fiber optic cable supporting grid modernization programs. Regulatory feasibility is discussed below.

If feasible, is it in the interest of the public?

Yes. It is in the public interest to identify, evaluate, and pursue any opportunity to accelerate the expansion of access to affordable broadband services given the widely recognized the social and economic benefits of such access. A potential cost effective middle-mile development strategy represents one opportunity, especially considering the collateral benefits of grid modernization programs that improve the delivery of electric services and that support digital automation technologies for customers.

If feasible, is it in the interest of the electric utility?

Yes. It is in the interest of the electric utility to support the installation of middle-mile fiber assets. Such development supports improved social, economic development, business retention and other goals for the customers and communities served by the utilities. It is also in the interest of the utility to promote broadband development to further optimize the operation of electric delivery systems, reduce outage frequency and duration, and to enhance customer programs.

If regulatory barriers exist, how can they be addressed?

Regulatory barriers exist, but the following recommendations are designed to support the development of regulatory, legal, and policy strategies that would facilitate electric utility support for broadband expansion to underserved and unserved areas:

1. Establish that electric utilities can recover costs, including but not limited to a reasonable return on and of investments, associated with middle-mile assets through a rate adjustment clause. Reasonable costs include any necessary permitting, amendments to or litigation around easements, material and labor.
2. Require that all revenue from the leasing of electric utility middle mile would, in turn, be credited to electric service customers.
3. Consider entering into contracts with providers who agree to lease the middle mile before the electric utility installs it.
4. State Corporation Commission (SCC) approval would be a prerequisite for any electric utility strategy to invest in middle-mile assets.
5. Electric utilities would maintain control over development and leasing of middle-mile fiber assets with oversight by the SCC, and possibly in collaboration with an agreed upon third party stakeholder organization that helps identify opportunities and market middle-mile assets.
6. Ideally, the terms and conditions for leasing middle-mile assets will be determined by the SCC in a rule-making, with guidance from the General Assembly, which will provide objectivity and transparency, and the pricing will be determined in an equally objective and transparent way.
7. Within the framework of approved grid modernization projects, electric utilities will have exclusive control for the scope, scheduling, and execution of projects to install, maintain, and repair fiber assets, including fiber route selection and build/splice schedules.
8. Electric utilities have control of the method of attachment and connection to transmission, distribution and fiber assets.
9. Electric utilities will manage and document the entities that lease fibers in order to manage operations, including outage notification and management.
10. Establish financial incentives for last-mile developers, municipal broadband authorities, and service providers to lease government or utility middle-mile assets.

Basis for Report

The General Assembly passed the Grid Transformation and Security Act ("Act"), which required Appalachian Power to "investigate the feasibility of providing broadband Internet services using utility distribution and transmission infrastructure" and required APCo to submit a report of this investigation to the Governor, State Corporation Commission, Broadband Advisory Council, and Chairmen of the House and Senate Committees on Commerce and Labor by December 1, 2018.[3]

Specifically, the Act requires APCo to consider the following in this report:

- Is it feasible to provide broadband services using distribution and transmission infrastructure?
- If feasible, is it in the interest of the public?
- If feasible, is it in the interest of the electric utility?
- If regulatory barriers exist, how can they be addressed?

APCo assembled a multi-discipline team from across its organization and externally to perform the study, including West Monroe Partners, which provided telecom industry perspective and expertise. The team met weekly from March through November with numerous breakout meetings and initiatives, including working with State Corporation Commission Staff as specified in the Act. Throughout the study, the team also met periodically with Evan Feinman and Courtney Dozier, Chief and Deputy Chief Broadband Advisors to the Governor, respectively. APCo also engaged local officials, state organizations, electric utility peers, internet service providers, wireless carriers, and others with an interest in expanding and improving broadband service availability to underserved and unserved areas of the Commonwealth. The team reviewed recent broadband studies from across the country to expand and validate its knowledge of various challenges and solutions to broadband expansion. Combined, the insight gained from these external resources was invaluable for developing the recommendations made in this study.[4]

The study first establishes a universe of potential blueprints for broadband expansion by assessing the fundamental requirements for development, examining current access in Virginia, and by reviewing various approaches, entities, and initiatives involved with deploying infrastructure and providing services. The study then evaluates how APCo could support such expansion within current and prospective electric transmission and distribution grid modernization programs. The final part of the report addresses the four areas of inquiry identified in the Act to determine the feasibility of electric utilities to more readily support broadband development.

[3] VAC 25.56-585.1:4.13. Signed March 9, 2018. https://lis.virginia.gov/cgi-bin/legp604.exe?181+sum+SB966

[4] Appendix A summarizes external meetings, studies, and reports used to support this study.

Drivers for Broadband Expansion

Importance of Broadband

Federal, state, and local entities have repeatedly recognized the importance of access to broadband services as a fundamental prerequisite for enabling economic development and for improving education, public safety, health care and government services, among other benefits. Nationally, the Federal Communications Commission ("FCC") National Broadband Plan states that:

> "Broadband is the great infrastructure challenge of the early 21st century. Like electricity a century ago, broadband is a foundation for economic growth, job creation, global competitiveness and a better way of life. It is enabling entire new industries and unlocking vast new possibilities for existing ones. It is changing how we educate children, deliver health care, manage energy, ensure public safety, engage government, and access, organize and disseminate knowledge."[5]

Within Virginia, broadband benefits have been characterized as follows:

> "Access to and adoption of reliable broadband provides a locality the opportunity to grow in almost every arena. Broadband impacts all areas of community life including local government, healthcare, education, economic development, and public safety. A community's ability to attract and retain economic development and its overall quality of life is dependent on infrastructure."[6]

At the local level, communities and counties in Virginia recognize the social and economic value afforded by broadband access and are proactively exploring potential opportunities. For example, Albemarle County evaluated potential broadband strategies and noted that:

> "World class broadband infrastructure will be necessary to maintain the county's attractiveness as a great place to live and to work. This can only be accomplished if the residents and businesses have the right telecommunications infrastructure that will support the needs of existing businesses and also attract new businesses… it is clear that broadband investments are critical for economic viability."[7]

In another example, the Franklin County Virginia Board of Supervisors established the Franklin County Broadband Authority in part because

> "[T]he Board of Supervisors…believes…access to affordable high-speed data, internet, and telecommunication services is important for fostering economic development,

[5] FCC, "Connecting America: The National Broadband Plan." 2010. p. XI.

[6] Center for Innovative Technology. Improving Broadband Access and Utilization in Virginia. 2015. p. 7.

[7] Albemarle County. Broadband Strategies. Oct 2016. p.4. www.albemarle.org/upload/images/forms_center/departments/Broadband/forms/Albemarle_broadband_strategies_161024.pdf

> improving educational opportunities, ensuring public safety, and enhancing the overall quality of life of the citizens of Franklin County."[8]

Opportunities for Broadband Expansion

A number of local, state, and federal efforts have attempted to estimate the extent of broadband access and quality across Virginia. Qualitatively, the scope of under and unserved areas has been characterized by the Commonwealth of Virginia Office of Telework Promotion and Broadband Assistance as follows:

> "At present, too many communities – both urban and rural – are not afforded access to affordable, reliable broadband telecommunications, and hence deprived of their ability to participate in enhanced social, education, occupation, healthcare, and economic development opportunities."[9]

Others attempt a more quantitative assessment. Consistently, these reports indicate that underserved and unserved areas are prevalent throughout the 38 county and city APCo region in southwest Virginia. The most recent Virginia Broadband Availability map in Figure 1 shows significant underserved or unserved regions across the Commonwealth. These areas are even more extensive considering that "the FCC data underlying the map overstates service provided due to federal reporting requirements for unserved and underserved areas."[10] For context, a map of the APCo service territory in Virginia is provided in Figure 2.

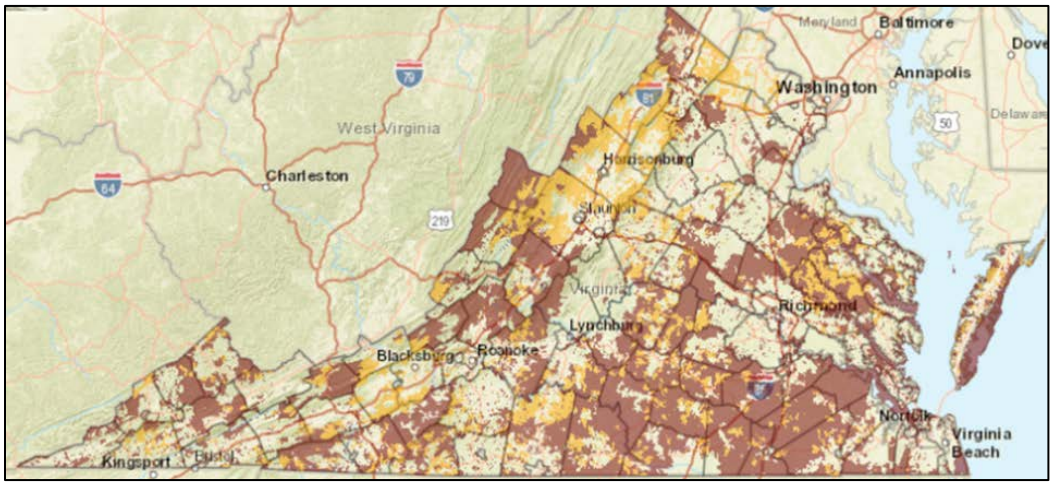

Figure 1: Virginia Map of Unserved (maroon) and Underserved (gold) Areas[11]

[8] Franklin County Board of Supervisors. "Resolution Adopting Franklin County Broadband Authority." Nov 2017. p. 1. www.franklincountyva.gov/broadband-authority

[9] Virginia Office of Telework Promotion and Broadband Assistance. www.wired.virginia.gov/content/basics

[10] Blueprint for Broadband: Expanding Broadband into Rural Virginia; Virginia Association of Counties. 2018. p. 4. www.vaco.org/wp-content/uploads/2018/06/P3RuralBroadbandBlueprint18.pdf

[11] Virginia Office of Telework Promotion and Broadband Assistance. www.wired.virginia.gov/broadband/coverage-maps

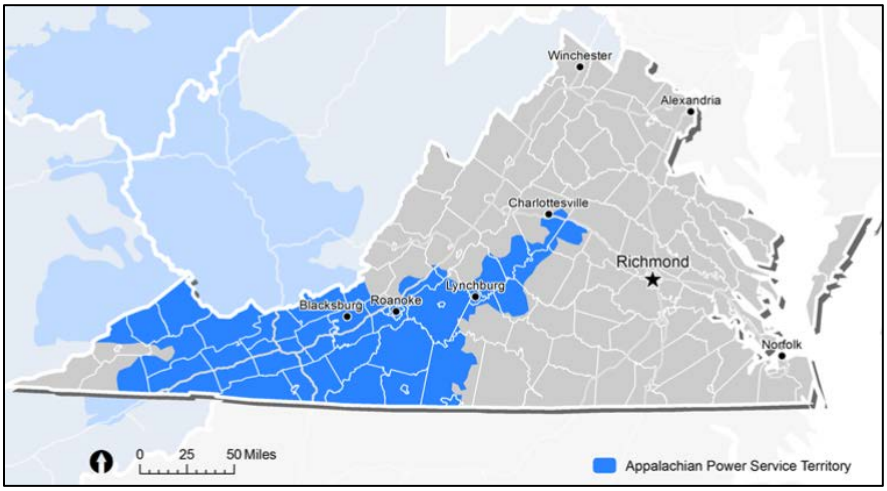

Figure 2: APCo Virginia Service Territory

Recognizing the value of affordable broadband access and the extent of areas that remain to be adequately serviced in Virginia, the Commonwealth is undertaking a number of initiatives to evaluate the issue, and to plan, incentivize, fund and accelerate the development of broadband infrastructure. For instance, the Virginia Department of Transportation ("VDOT") is engaged in a Fiber Optics Opportunities Initiative to assess opportunities for using existing and future VDOT fiber optic resources to support broadband expansion.[12] In 2018, Governor Northam signed legislation requiring locality comprehensive plans to consider strategies to develop broadband services that is sufficient to meet the current and future needs of residents and businesses.[13] Further, Governor Northam recently appointed Evan Feinman and Courtney Dozier to the new positions of Chief and Deputy Chief Broadband Advisors, respectively, in order to "develop a plan to get broadband to every single Virginian as soon as possible."[14]

The increasing recognition of the importance of expanding broadband is also evidenced by the number of Commonwealth and Federal funding programs available to incentivize and facilitate infrastructure development. In 2018, the Virginia Tobacco Commission approved nine funding requests totaling more than $11 million for broadband expansion projects in Southern and Southwest Virginia.[15] Additionally, the Virginia Department of Housing and Community Development, which provides financial assistance for broadband development through the Virginia Telecommunications Initiative, received $4 million to award in 2019.[16] At the federal level, the FCC, through its Connect America Program Phase II, offers funding to support the development of upgraded and new infrastructure to underserved areas. Up to $46 million is available in Virginia through this program.[17]

[12] www.p3virginia.org/projects/vdot-fiber-optics/

[13] Virginia House Bill 640. https://legiscan.com/VA/bill/HB640/2018

[14] www.roanoke.com/news/virginia/gov-ralph-northam-announces-new-initiative-to-bring-high-speed/article_0b683d1b-a2ac-5277-89f0-6688d3dba2aa.html

[15] www.revitalizeva.org/2018/03/12/31218-tobacco-commission-approves-funding-requests-for-broadband-expansion/

[16] www.dhcd.virginia.gov/index.php/dhcd-resources/trainings-and-workshops/8-trainings-and-workshops/363-vati-input-session.html

[17] www.wired.virginia.gov/broadband/virginia-awards

Development initiatives and funding programs are expected to continue to support the goals of expanding broadband access throughout the Commonwealth. APCo views these funding programs as being best reserved for last-mile developers and service providers. With a focus solely on supporting the development of middle-mile fiber optic cable infrastructure as a collateral benefit of grid modernization programs, APCo will not pursue Federal or Commonwealth funding.

Aspects of Broadband Development

Before evaluating the feasibility of electric utilities to support development, it is necessary to review key elements of the broadband network; identify primary entities involved in the development and operation of this network; and summarize challenges to growth, especially as they relate to rural areas.

Middle Mile and Last Mile

Key aspects of the broadband network considered in this study are the "middle mile" and the "last mile." The middle mile refers to the infrastructure connecting the last-mile service network to a provider's backbone network that ultimately provides access to the global internet. The last mile involves the infrastructure connections and services provided to the end user. In general, the middle mile primarily consists of fiber optic cable, while the last mile is comprised of variety of wired and wireless options designed to meet the characteristics of end users, topographic features, and other service territory-specific variables. Various entities have invested in middle-mile and last-mile assets, including local exchange carriers, wireless carriers, municipalities, as well as electric and telecommunication cooperatives. APCo is only evaluating the feasibility of supporting the development of middle-mile infrastructure in context with APCo grid modernization programs. This strategy aligns with the scope of grid modernization program that inherently include fiber capacity, and avoids the development, regulatory, and competitive risks associated with last-mile connection and internet service offerings.

Broadband Development

Much of the broadband infrastructure and services in Virginia have been developed for the purpose of meeting customer demand, enhancing education, government, public safety, and other services, or supporting internal business functions. As a result, densely populated areas and critical institutions, such as schools, hospitals, and public safety resources, have generally been the focus of broadband deployment. The patchwork map of underserved areas shown in Figure 1 reflects the outcome of this approach.

Broadband infrastructure within the Commonwealth has been planned and developed by a variety of entities. For example, VDOT operates over 1,000 miles of fiber optic cable and has identified over 3,700 miles of routes for fiber resource sharing.[18] Mid-Atlantic Broadband owns and operates more than 1,800 miles of open-access fiber in 31 counties.[19] Lumos Networks and Sprint Communications have installed fiber in different parts of Virginia.[20] APCo and other electric utilities also have fiber optic networks across portions of their grids to support internal

[18] www.p3virginia.org/wp-content/uploads/2018/04/Fiber-Optics-Opportunities-Initiative-Feb-21-2018.pdf

[19] https://mbc-va.com/network/

[20] www.lumosnetworks.com/business/fiber-maps

operations such as metering, supervisory control and data acquisition ("SCADA"), protective relaying, security, and other internal communication needs.

Central Virginia Electric Cooperative has initiated a five-year project to install 4,500 miles of fiber across 14 counties in order to provide broadband to all 36,000 of its members.[21] Likewise, BARC Electric Cooperative is completing a project to install 400 miles of fiber in 2018.[22] Citizens Telephone Cooperative is building 186 miles of open access middle-mile fiber across seven counties, which includes eight primary interconnection points strategically positioned to access under and unserved areas, as well as to tie into other open access networks. The design allows wireless and other providers to offer services to areas where service was previously unavailable or uneconomical to develop.[23]

Localities in Virginia are also engaged in various efforts to accelerate the pace of broadband expansion. This includes preliminary efforts to evaluate opportunities and initiate development planning, such as the 2018 broadband assessment and fiber development plan for Grayson County,[24] the 2017 Telecommunications Survey in Botetourt County,[25] and the 2016 evaluation of broadband strategies for Albemarle County.[26] Some localities have also developed and own broadband infrastructure. For example, Nelson County established the Nelson County Broadband Network that developed and owns a 39-mile middle-mile fiber optic network and four towers designed to extend wireless communication services to more remote areas in the county. Nelson County's middle-mile infrastructure is an open access network that provides equal access to and allows for competition among private service providers.[27] Further, the Roanoke Valley Broadband Authority continues to develop a network with over 80 miles of carrier-grade, open access fiber installed to date.[28] The aforementioned examples represent only a portion of the many ongoing efforts to expand affordable broadband access across Virginia.

Prerequisites for Successful Broadband Expansion

Any program to broaden access to broadband services in Virginia should consider the following:

1. **Standardized Definitions of Broadband and Deployment Goals**

   As technology, funding programs, and regulatory oversight have evolved, so too has the definition of broadband. In 2010, the FCC defined broadband as 4 Mbps/1 Mbps

[21] www.mycvec.com/community/broadband

[22] http://remagazine.coop/barc-electric-broadband-project/

[23] https://citizens.coop/citizens-telephone-cooperative-awarded-community-comprehensive-infrastructure-cci-grant-ntia-build-middle-mile-fiber-network-nrv-region-virginia/ and https://citizens.coop/fiberexpansion/

[24] https://graysoncountyva.gov/wp-content/uploads/2018/06/BOS-Minutes-5-10-18.pdf

[25] www.botetourtva.gov/documents/econ_dev/2017_Botetourt_Telecommunications_Survey_Digital.pdf

[26] www.albemarle.org/upload/images/forms_center/departments/Broadband/forms/Albemarle_broadband_strategies_161024.pdf

[27] www.nelsoncounty-va.gov/government/broadband-authority/

[28] www.yesroanoke.com/index.aspx?NID=331

(download/upload speeds), which was revised to 25/3 Mbps in 2015. The FCC Lifeline funding program defines broadband as 15/2 Mbps, while the FCC Connect America Fund program requires minimum broadband speeds of 10/1 Mbps.[29] Given the range of definitions and the continued advancement of technical capabilities, it is critical that any Commonwealth initiative for broadband expansion clearly specify the minimum performance required to meet the goals of the program. As noted by the Congressional Research Service:

> "How broadband is defined and characterized in statute and in regulation can have a significant impact on… broadband policies and how… resources are allocated to promote broadband deployment in unserved and underserved areas."[30]

For purposes of the APCo study, "broadband" refers to the current FCC definition of 25 Mbps upload and 3 Mbps download.

2. Knowledge of Underserved Areas and Existing Infrastructure

More precise identification of the location of underserved areas and the location of existing and planned infrastructure are needed to rationally plan, design, and construct broadband infrastructure. The Virginia Association of Counties highlighted the need for more detailed information by noting that:

> "Collecting accurate data on unserved and underserved areas across the Commonwealth continues to lack meaningful and accurate forward movement without setting a state definition for unserved and underserved areas."[31]

As previously discussed, a number of entities have deployed or are developing broadband assets in the Commonwealth. It is recognized that in some instances the location and plans for infrastructure is business sensitive. However, in other cases, and in particular those funded by the public, a greater knowledge of existing and planned infrastructure would more efficiently enable parties to identify and collaborate on opportunities to accelerate and more economically expand broadband access.

3. Strategies for Areas with Low Population Densities

For many areas in Virginia, especially within the APCo service territory, efforts to expand broadband access must address significant barriers associated with low population densities and topography. As concluded in the FCC National Broadband Plan:

> "[T]he cost of … middle-mile connectivity has a direct impact on the cost of providing broadband service in unserved areas of the country." (p. 148) In fact, the "middle-mile

[29] Congressional Research Service. "Defining Broadband: Minimum Threshold Speeds and Broadband Policy." 2017. p. 6-9.
[30] Congressional Research Service. "Defining Broadband: Minimum Threshold Speeds and Broadband Policy." 2017.p. 1.
[31] Virginia Association of Counties. "Blueprint for Broadband: Expanding Broadband into Rural Virginia." 2018. p.4.

> transmission often represents a significant cost for carriers that need to transport their traffic a significant distance to the Internet backbone."[32]

Further describing the unfavorable economics of expanding to low population and geographically isolated areas, the National Broadband Plan notes that:

> "The rates that firms pay for these critical middle- and second-mile connections have an impact on the business case for the provision of broadband in high-cost areas. Small local exchange carriers, wireless firms and small cable companies typically purchase these connections from other providers. It may well be the case that the cost of providing these circuits is so high that there is no private sector business case to offer broadband in some areas, even if the rates, terms and conditions are just and reasonable."[33]

Thus, this suggests that if middle-mile infrastructure can be more cost effectively deployed in under and unserved regions, then the business case for investing private capital for last-mile development and services becomes more viable. This is especially true if funding from Commonwealth and Federal programs can be accessed.

4. Broader Strategic Planning

Expanding broadband is a two-fold challenge that involves not only the deployment of necessary physical infrastructure, but also the implementation of business plans to utilize that infrastructure to provide affordable access to services. Ideally, the planning and execution of initiatives to develop these middle mile and last-mile investments would occur in parallel as the success of both is dependent on the success of the other. This dependence is discussed in the National Broadband Plan, which states:

> "[b]y solving the middle-mile problem, the hope is to foster investment in "last-mile" facilities to provide service to individuals and institutions that need it." [34]

When broader collaboration occurs to strategically plan, construct, and operate broadband networks, then there is a stronger likelihood for more cost-effective and successful development. The FCC National Broadband Plan notes that strategically planning expansion efforts can produce more cost effective and feasible solutions:

> "Because broadband networks—particularly fiber optic networks—demonstrate large economies of scale, bulk purchasing arrangements for forms of connectivity like second-mile and middle-mile access can drive down the per-megabit cost of such access considerably."[35]

[32] FCC. "Connecting America: The National Broadband Plan." 2010. p. 140.
[33] FCC. "Connecting America: The National Broadband Plan." 2010. p. 143.
[34] FCC. "Connecting America: The National Broadband Plan." 2010. p. 343.
[35] FCC. "Connecting America: The National Broadband Plan." 2010. p. 154.

Focusing solely on middle-mile or last-mile deployment does not guarantee expanded access and can present significant cost and development risk. For example, an important lesson learned from one middle-mile development project was that:

> "The cost of building that last mile is the same obstacle Nelson County has encountered in building towers to help bring broadband to rural areas, and it's the reason that RANA opted for DSL for harder to reach places. Failing to appreciate the cost to join the network would prove a barrier to its success is another lesson of the lessons learned." [36]

and

> "Don't concentrate solely on building a network. It is just as important to begin early with management in place that is focused on running an organization, gaining commitments from both institutional customers and multiple service providers, and having cash on hand, like any startup company, to sustain the authority until income offsets expenses."[37]

Understanding these risks upfront and planning accordingly can improve the potential for success. Central Virginia Electric Cooperative ("CVEC") is actively developing broadband infrastructure and services for its members, but has recognized these types of risks upfront, which allows the company to more proactively take steps to mitigate potential impacts that could impede the success of the project:

> "[CEO Gary] Wood said CVEC plans to begin installing infrastructure in five counties for the pilot year and three to four additional counties during the second year. The project would have yearly losses for the first seven years until CVEC builds enough business to make positive margins, Wood said. Without any federal, state or local funding, CVEC wouldn't start making a profit until year 11. "If you wonder why large companies don't do this," Wood said, "You see why; they can't do it."[38]

Similarly, a study of broadband strategies for Albemarle County, Virginia, identified the risks of developing broadband assets in a vacuum without consideration of if or how those assets would be used to provide affordable access. The study notes that:

> "Broadband is not a silver bullet for Albemarle. Broadband investments need to be tied to a wider set of community and economic development strategies that help make the area an engaging and interesting place to locate and run a business and a vibrant and interesting place to live. Communities that have made broadband investments without

[36] The Roanoke Times. "Rockbridge County Broadband Project Acts as Lesson." 2014. www.roanoke.com/news/rockbridge-county-broadband-project-acts-as-lesson/article_af2ada6c-8619-11e3-a34c-001a4bcf6878.html

[37] The Roanoke Times. "Rockbridge County Broadband Project Acts as Lesson." 2014. www.roanoke.com/news/rockbridge-county-broadband-project-acts-as-lesson/article_af2ada6c-8619-11e3-a34c-001a4bcf6878.html

[38] Nelson County Times. "Nelson County Broadband Authority Discusses CVEC Broadband Initiative." 2018. www.newsadvance.com/nelson_county_times/news/nelson-county-broadband-authority-discusses-cvec-broadband-initiative/article_ad596de7-d51e-5685-91f3-becob6330b56.html

> taking the time to identify a broader set of goals and expected outcomes have usually been disappointed when broadband investments have not had much of an impact."[39]

In summary, investing in strategic planning upfront for both deploying broadband infrastructure *and* for subsequent affordable access to services is a critical prerequisite for the success of any development program.

[39] Albemarle County. Broadband Strategies. October 2016. p. 4.

APCo Strategies for Meeting Broadband Expansion

Key Working Assumptions

APCo defined the following working assumptions as a foundation for identifying potential strategies to support broadband expansion:

- APCo is focused solely on the development and ownership of middle-mile fiber and will not develop last-mile infrastructure.
- APCo will not compete with broadband providers to directly serve customers.
- APCo is focused on fiber optic cable, not communications equipment.
- APCo middle-mile fiber will support the FCC connectivity definition of 25/3 Mbps.
- APCo will employ strategic connection points for offsite access by third parties.
- APCo middle-mile fiber will be installed in the power supply zone.[40]
- Only APCo or APCo-certified crews will install middle-mile fiber due to safety and reliability requirements.
- Only APCo or APCo-certified crews will maintain and restore middle-mile fiber.
- APCo must reserve a portion of any new middle-mile fiber for internal use.
- APCo must be able to recover costs from its electric service customers, including but not limited to operations and maintenance costs and a reasonable return on and of investments associated with middle-mile assets through a rate adjustment clause. All lease revenue would, in turn, be credited to electric service customers.
- APCo would maintain discretion to develop and lease middle-mile fiber, but will partner on use by working with an agreed-upon stakeholder organization.
- APCo will not seek grants or government funding for middle-mile development.
- Any strategy must align with APCo grid modernization programs.
- Any strategy must align with APCo safety and physical/cyber security standards.

Potential APCo Strategies

APCo continues to invest in transmission and distribution initiatives designed to enhance operations, outage management, reliability, and customer programs. Collectively, this report refers to these current and future transmission and distribution projects as APCo *grid modernization programs*. Based on the working assumptions above, the most practical and low-cost strategy to support broadband expansion to underserved and unserved areas in APCo's service territory is to expand various APCo grid modernization programs to include middle-

[40] Per AEP Telecom standards placement of an ADSS Fiber will be 12" below a distribution neutral running in parallel on a single and three phase system which is supported by NESC & NEC rules. Per the NESC rule 230F1b clearance for the ADSS Fiber cable will be treated the same as a neutral conductor meeting NEC rule 230E1 being located in the supply space. Per NESC Table 235-5 Not less than 30" of vertical clearance between the communication cable in the supply space and the communication cable in the communication space per the NESC Table 235-5, Footnote 5. Footnotes 9 and 10 apply to the vertical clearance between the neutral conductor and the communication cable in the supply space. Bonding is not required for entirely dielectric cables meeting Rule 230F1b. Please refer to Figure 235-13 in the NEC.

mile fiber capacity. In particular, by installing additional fiber in the power supply zone of poles as part of planned grid modernization programs, the APCo strategy has the potential to offer cost and scheduling efficiencies for developing middle-mile assets. This approach would have the co-benefit of accelerating the implementation of both APCo modernization programs and broadband access.

Current and prospective APCo grid modernization efforts include the transmission telecom modernization program, customer experience programs and outage management initiatives, as well as prospective "electric distribution grid transformation projects" defined by the Act. An overview of each follows. These strategies can support broadband expansion, but success is dependent on the collaboration of other stakeholders to utilize the middle-mile fiber and provide affordable access.

1. **Transmission Telecommunications Modernization Program**

APCo has experience in using fiber optic cable to support internal communications and operations with nearly 300 miles of fiber installed on transmission assets in Virginia. The AEP transmission telecommunications modernization program ("TTMP") began in 2016 for the purpose of improving the capacity, resiliency, and operation of the telecommunications system across the AEP system, including the APCo Virginia service territory. The program is designed to enhance current transmission projects to improve existing and establish new fiber optic cable routes and equipment. The TTMP will develop a more robust communications network with greater connectivity to substations and other transmission assets, which will enhance operational performance, outage management efficiency, and customer programs. By the end of 2019, over 400 additional miles of fiber is planned to be installed as part of the TTMP. Ultimately, complete implementation of the TTMP will require over 1,600 miles of fiber deployed in Virginia by the mid-2020's.

The TTMP has the potential to support broadband expansion by extending the reach of middle-mile fiber. The strategy would involve increasing the capacity of the fiber optic cable by including a greater number of fiber strands. To illustrate, the scope of a TTMP project originally designed to install a single cable with 48 individual fiber strands would be expanded to deploy a single cable with 96 strands with the added capacity being available to lease as a middle-mile asset. As discussed later, the additional fiber capacity achieved by this strategy has the potential to be a cost effective means of deploying middle-mile assets.

2. **Customer and Outage Management Programs**

APCo is actively planning and implementing projects to enhance and improve the distribution system with respect to outage management, security, distribution automation, and customer programs. Many projects involve systems that require the installation of fiber optic cable, including those related to advanced metering infrastructure ("AMI") and distribution automation circuit reconfigurations.

APCo is currently replacing all meters with AMI across its service territory. The program began in 2017 and will include over one million new meters by its conclusion in 2022. For APCo's Virginia service territory, the company is anticipated to invest over $100 million to install an estimated 551,000 meters by the end of 2022. Over 75 percent of these meters will be deployed by the end of 2019. Beyond 2019, the remaining areas are generally the more rural portions of APCo's Virginia service territory where communication network installation and meter replacement is more challenging. The new meters communicate with central data collection points to more efficiently operate the distribution system, respond to outages and support customer programs. Collection points commonly support 6,000 to 8,000 meters and are located on distribution power poles. Wireless and wired technologies are options for facilitating the communication between these remote collectors and APCo operating centers. Although fiber-linked collection points present a more robust design to enhance operational and customer programs, it is often more cost effective, especially in rural areas, to rely on wireless options. However, if the design of collection points could also support broadband expansion, then the collateral benefits of extending middle-mile assets and establishing a more robust distribution network may justify linking remote collection points with fiber cable.

Another distribution strategy that could potentially support broadband expansion is the installation of distribution automation circuit reconfiguration ("DACR") equipment. DACR enables circuits to respond to fault conditions using nearby circuits to reconfigure the local distribution system, which, in turn, reduces the frequency and duration of outages. DACR equipment must be able to communicate with other parts of the distribution system, which can occur via wireless or wired technologies, including fiber optic cable. Although APCo considers DACR when developing strategies for improving lower reliability circuits, it does not have a formal plan for widespread deployment. Currently, less than 10 percent of the distribution feeders on the APCo Virginia network employ DACR, in part, because the configuration of the existing system and associated reliability priorities can more effectively be addressed through strategies other than DACR. However, opportunities to support broadband development may rationalize a greater use of DACR, and associated fiber, for the co-benefit of improved distribution operations and greater access to middle-mile fiber.

3. Prospective "Electric Distribution Grid Transformation Projects"

The Act deems "Electric distribution projects" [to be] "in the public interest," and includes provisions related to the recovery of costs for "electric distribution grid transformation projects." Specifically, the Act notes:

> "To ensure the generation and delivery of a reliable and adequate supply of electricity, to meet the utility's projected native load obligations and to promote economic development, a utility may at any time, after the expiration or termination of capped rates, petition the Commission for approval of a rate adjustment clause for recovery on a

> timely and current basis from customers of the costs of… one or more electric distribution grid transformation projects."[41]

The Act defines an "electric distribution grid transformation project" as:

> "A project associated with electric distribution infrastructure, including related data analytics equipment, that is designed to accommodate or facilitate the integration of utility-owned or customer-owned renewable electric generation resources with the utility's electric distribution grid or to otherwise enhance electric distribution grid reliability, electric distribution grid security, customer service, or energy efficiency and conservation, including advanced metering infrastructure; intelligent grid devices for real time system and asset information; automated control systems for electric distribution circuits and substations; communications networks for service meters; intelligent grid devices and other distribution equipment; distribution system hardening projects for circuits, other than the conversion of overhead tap lines to underground service, and substations designed to reduce service outages or service restoration times; physical security measures at key distribution substations; cyber security measures; energy storage systems and microgrids that support circuit-level grid stability, power quality, reliability, or resiliency or provide temporary backup energy supply; electrical facilities and infrastructure necessary to support electric vehicle charging systems; LED street light conversions; and new customer information platforms designed to provide improved customer access, greater service options, and expanded access to energy usage information."[42]

Similar to the strategies described above for customer facing and outage management programs, this strategy would seek common efficiencies with future APCo "electric distribution grid transformation projects" defined by the Act to deploy fiber for middle mile purposes.

[41] VAC 25.56-585.1:4.13. Signed March 9, 2018. https://lis.virginia.gov/cgi-bin/legp604.exe?181+sum+SB966

[42] Id.

Feasibility of APCo Strategies

The feasibility of APCo to align current and prospective grid modernization programs to support broadband expansion to underserved and unserved areas is evaluated below.

Technical Feasibility

The Act requires an evaluation of the maturity of available technologies to support broadband and the feasibility of their integration with electric transmission and distribution infrastructure. APCo identified the use of fiber optic cable as the only technically feasible option that can meet both the needs of APCo's grid modernization programs and the performance demands of a middle-mile network. APCo has a history of successfully deploying, operating, and maintaining fiber optic cable to support internal communications and electric grid operations. This direct experience demonstrates that it is technically feasible not only to deploy a single cable with a greater number of fiber strands, but also to isolate and lease individual fiber strands to third parties. APCo considered alternatives to fiber optic cable, but determined that each was not feasible due to technical and performance limitations, cost considerations, or because they are insufficient to support the APCo grid modernization programs. Alternative approaches eliminated include broadband over powerlines, microwave communications, and TV white space technologies.

Execution Feasibility

With respect to project execution, the Act requires the study to evaluate the feasibility of potential strategies to be (i) compatible with existing electrical services and (ii) able to reach unserved areas. By expanding the scope of current grid modernization programs to include capacity for middle-mile broadband, APCo would improve existing electrical services in concert with supporting broadband expansion. In fact, the inclusion of broadband fibers has the potential to extend the reach of grid fiber, which would correspondingly strengthen and improve the delivery of electrical services deeper into the APCo service territory that may otherwise be difficult to accomplish alone. The APCo region is predominately rural and has extensive areas of underserved broadband access. Thus, strategies that serve to extend APCo grid modernization efforts would also support Commonwealth goals to reach underserved areas. Another consideration is that the timing of APCo's planned installation of AMI and associated collection points to more rural areas could align well for executing projects with the collateral benefit of middle-mile deployment.

Financial Feasibility

The financial feasibility of potential broadband support strategies is a key aspect of the evaluation required by the Act. This is because low population densities and difficult terrain have made broadband offerings to underserved and unserved areas unattractive to current internet service providers. These factors were consistently recognized during the various meetings with external stakeholders and within the feasibility studies reviewed by APCo. The

current and prospective APCo grid modernization programs have the potential to overcome these challenges and provide a cost-effective middle-mile alternative needed to improve the economics of the deployment of last-mile services by others.

APCo strategies to support broadband development involve increasing the capacity of fiber that APCo would install to support its grid modernization programs for the collateral benefit of middle-mile expansion. For currently planned projects, the amount of individual fiber strands within the cable would be increased so that the added capacity could be leased as a middle-mile asset. In this scenario much, if not all, of the ancillary project costs would be included in the original project scope. This includes costs for baseline pole inspections, make-ready work, pole replacements, as well as the material and labor cost for installation. Incremental costs for the added middle-mile capacity would, in general, represent material costs and the labor associated with additional line splicing. While actual incremental costs are project-specific, a general estimate based on experience and a review of external resources indicates that doubling the fiber capacity of planned and designed project from 48 to 96, for example, would nominally add approximately 10 percent to the cost of fiber cable and installation labor. These nominal cost additions would be higher for projects planned and designed specifically for the purpose of grid modernization and middle-mile development. For both planned and prospective projects, the incremental cost of adding fiber capacity for middle-mile assets appear to be financially feasible. Resulting cost savings from this economy of scale can then be shared between electric service customers and broadband leaseholders, the latter of which would provide an incentive to expand broadband service.

Consideration of middle-mile expansion opportunities may also extend the reach of fiber-backed distribution related technologies such as metering collection devices and DACR, which are challenged by the low population density and terrain of the same rural areas that are unserved with broadband access. While the needs of distribution technologies could be potentially met, in part, through wireless options, a fiber-backed network would provide for more robust outage management, grid operation and customer services. Although it may be financially challenging to independently deploy fiber to some regions solely for broadband or grid modernization purposes, leveraging the collateral benefits of both has the potential to sufficiently address these challenges to enable fiber cable to be extended deeper into the APCo service territory and to many unserved areas.

These strategies for supporting broadband expansion become even more financially viable with consideration of potential investment offsets to be realized by returning middle-mile lease revenue to electric service customers. Through leasing middle-mile fiber and returning all of the revenue to customers, the incremental cost of the added fiber capacity would be reduced or potentially overcome altogether. Further, factoring in the co-benefit of middle-mile assets to extend the reach of fiber-linked distribution grid metering collection points has the potential to be more cost effective than wireless options that would otherwise be deployed solely to support grid modernization projects.

The aforementioned strategies involve the expansion of middle-mile assets. Last-mile development and affordable service offerings are needed to successfully expand broadband. A number of Commonwealth and Federal funding programs are available for broadband development. APCo views the resources as best reserved for last-mile providers as a continued offset to the high cost and risk of servicing low population areas. APCo will not pursue such funding.

Regulatory Feasibility and Legal Considerations

The Act requires the study to include a "determination of regulatory barriers… and proposed[d] legislation to address those barriers" related to the "feasibility of… using utility distribution and transmission infrastructure" to support broadband expansion.[43] Regulatory feasibility is evaluated below, along with a review of legal and strategic policy considerations that could optimize or delay support for broadband expansion.

1. Cost Recovery

The most significant barrier is that of cost recovery, as APCo must be able to recover costs, including but not limited to costs of installation, operation and maintenance of, and a reasonable return of and on its capital investments in the middle-mile assets through a rate adjustment clause. All middle-mile lease revenue would in turn be credited to electric service customers. The Virginia Code does not currently provide for the recovery of these costs, as they would not be incurred in the delivery of electric service to APCo's clients.

2. Easements

Another consideration for middle-mile development involves the terms of existing electric utility easements. APCo has the right to install and maintain transmission and distribution assets through easements granted by individual property owners, but it does not own the rights of way upon which the majority of distribution assets are installed. Most existing easements, especially most recent easements, are identical and appear to allow APCo to install assets that are not used in the provision of electric service and to lease those assets to a third party. However, existing APCo easements coupled with FCC-related competitive factors preclude the indiscriminate build out by electric utilities of fiber optic cable for the sole purpose of communications or middle-mile use. Thus, where existing easements allow for communications related use, at least a portion of any new utility installed fiber must be to support the services involved with the delivery of electricity. To the extent that new easements must be obtained to support electric utility deployment of middle-mile assets, this can add cost and time to development process and could impact the feasibility of an individual project. Foremost in addressing this issue is the need for proper due diligence during the design and planning phase of a project to review all existing easements and to take steps to mitigate potential issues through acquiring new easements or by redesigning the project route. Both

[43] VAC 25.56-585.1:4.13. Signed March 9, 2018. https://lis.virginia.gov/cgi-bin/legp604.exe?181+sum+SB966

mitigation approaches have the potential to add costs and time to a project. As discussed in the risk considerations below, additional recommendations around the use of current easements were viewed as critical because of their ability to impact the incremental cost and the State Commission's view of need and prudency.

3. Asset Classification

Classification of middle-mile fiber assets as general, transmission or distribution plant for ratemaking purposes could add complexity to approval, cost-recovery and leasing processes. The State Corporation Commission would approve and have oversight of distribution assets and general plant assigned for recovery through distribution rates. Projects classified as transmission assets or general plant allocated or assigned to transmission could potentially fall under FERC jurisdiction, in which case revisions to FERC formula rates necessitating FERC approval would be required, which would add time, cost and uncertainty to development, up to and including preventing any such development. Therefore, the development of middle-mile fiber could be optimized if the infrastructure is classified as distribution or general plant assigned to distribution for ratemaking purposes.

4. Third Party Partnership

Achieving the Commonwealth goal of expanding broadband access to underserved areas will require both the development of infrastructure and the utilization of that infrastructure. In order to maximize the utilization of middle-mile assets and avoid competing with last-mile service providers, a third party entity is needed to help with identifying development opportunities and marketing of middle-mile assets. While APCo would maintain discretion for developing and leasing middle-mile assets through collaboration with a process monitored by the State Corporation Commission, a third party could be helpful in assisting to maximize the use of the broadband assets. Details were not developed on the specific composition, governance, or responsibilities of this entity as the input from many stakeholders is needed to determine the best approach. Regardless of the arrangement, the need for clearinghouse-type functions to assist in identifying underserved areas and marketing middle-mile assets would add value in helping to expand access to affordable broadband services.

5. Recommendations

The following recommendations were identified for the combined purpose of supporting the development of regulatory, legal, and policy strategies that would facilitate electric utility support for broadband expansion to underserved and unserved areas.

a. Establish that electric utilities can recover costs, including but not limited to a reasonable return on and of investments, associated with middle-mile assets through a rate adjustment clause. Reasonable costs include any necessary permitting, amendments to or litigation around easements, material and labor.

b. Require that all revenue from the leasing of electric utility middle mile would, in turn, be credited to electric service customers.

c. Consider entering into contracts with providers who agree to lease the middle mile before the electric utility installs it.

d. State Corporation Commission approval would be a prerequisite for any electric utility strategy to invest in middle-mile assets.

e. Electric utilities would maintain control of development and leasing middle-mile fiber assets with oversight by the SCC, and possibly in collaboration with an agreed upon third party stakeholder organization that helps identify opportunities and market middle-mile assets.

f. Ideally, the terms and conditions for leasing middle-mile assets will be determined by the SCC in a rule-making, with guidance from the General Assembly, which will provide objectivity and transparency, and the pricing will be determined in an equally objective and transparent way. Leasing terms should not place any undue or restrictive encumbrances on the electric utilities that would interfere with their own electric service planning and operations. Electric utilities should not be subject to any performance guarantees or priorities that negatively impact electric service. Electric service should remain the priority in service restoration in the event of an outage.

g. Within the framework of approved grid modernization projects, electric utilities will have exclusive control for the scope, scheduling, and execution of projects to install, maintain, and repair fiber assets, including fiber route selection and build/splice schedules.

h. Electric utilities have control of the method of attachment and connection to distribution and fiber assets.

i. Electric utilities will manage and document the entities that lease fibers in order to manage operations, including outage notification and management.

j. Establish financial incentives for last-mile developers, municipal broadband authorities, and service providers to lease government or utility middle-mile assets.

Risk Considerations

Risks with the potential to affect the objective of expanding affordable broadband access in conjunction with current utility programs were evaluated. The evaluation was a quantitative assessment looking at the probability and impacts of the feasibility issues identified by a cross functional team at APCo. The evaluation highlights the importance of our recommendations on required language for cost recovery to ensure current barriers are removed as the level of risk for the issue identified exceeds our corporation's risk appetite and interest in pursuing middle mile development.

While it would not prohibit APCo from pursuing middle-mile development, additional recommendations around asset classification, the use of current easements, and third party oversight of development were viewed as critical because of their ability to impact the incremental cost and the State Commission's view of need and prudency.

It is also important to note operational safety measures that APCo will mandate as Zero Harm to our employees and contractors and the public is a key corporate objective. In the event of physical damage to the assets utilizing common infrastructure, restoration of middle-mile broadband service will only begin after electric service is reestablished and the safety of workers is assured. Customers relying on utility middle-mile broadband service should be aware and plan accordingly based on this. In addition, APCo will only be using currently approved contractors to install fiber because of their knowledge of hazards in the power space and the associated controls to reduce the risk.

Response to Grid Transformation & Security Act Inquiries

This study evaluates the feasibility of aligning future electric grid development efforts and broadband expansion goals by addressing inquiries specified in the Act. Responses to those inquiries and related recommendations are provided in the sections below.

Is it feasible to provide broadband services using distribution and transmission infrastructure?

Possibly, but real barriers were identified. It is technically feasible to provide broadband infrastructure using electric utility assets. It is also feasible for electric utilities to execute a strategy that can bring middle-mile infrastructure to underserved and unserved regions by the efficient utilization of current and prospective grid modernization programs. Execution of these strategies through the electric utility installing fiber within the power zone of poles provides for increased efficiencies in terms of the timing and cost of deployment. Proper due diligence during the planning and design phase could add cost and time to projects if new easements must be obtained. Financially, it is cost effective to add capacity to existing fiber deployments that are part of grid modernization programs. Plus, the co-benefits of broadband can make it more cost effective to extend the reach of fiber optic cable supporting grid modernization programs. Regulatory feasibility is discussed below.

If feasible, is it in the interest of the public?

Yes. It is in the public interest to identify, evaluate, and pursue any opportunity to accelerate the expansion of access to affordable broadband services given the widely recognized the social and economic benefits of such access. A potential cost effective middle-mile development strategy represents one opportunity, especially considering the collateral benefits of grid modernization programs that improve the delivery of electric services and that support digital automation technologies for customers.

If feasible, is it in the interest of the electric utility?

Yes. It is in the interest of the electric utility to support the installation of middle-mile fiber assets. Such development supports improved social, economic development, business retention and other goals for the customers and communities served by the utilities. It is also in the interest of the utility to promote broadband development to further optimize the operation of electric delivery systems, reduce outage frequency and duration, and to enhance customer programs.

If regulatory barriers exist, how can they be addressed?

Regulatory barriers exist, but the following recommendations are designed to support the development of regulatory, legal, and policy strategies that would facilitate electric utility support for broadband expansion to underserved and unserved areas:

1. Establish that electric utilities can recover costs, including but not limited to a reasonable return on and of investments, associated with middle-mile assets through a rate adjustment clause. Reasonable costs include any necessary permitting, amendments to or litigation around easements, material and labor.
2. Require that all revenue from the leasing of electric utility middle mile would, in turn, be credited to electric service customers.
3. Consider entering into contracts with providers who agree to lease the middle mile before the electric utility installs it.
4. State Corporation Commission (SCC) approval would be a prerequisite for any electric utility strategy to invest in middle-mile assets.
5. Electric utilities would maintain control over development and leasing of middle-mile fiber assets with oversight by the SCC, and possibly in collaboration with an agreed upon third party stakeholder organization that helps identify opportunities and market middle-mile assets.
6. Ideally, the terms and conditions for leasing middle-mile assets will be determined by the SCC in a rule-making, with guidance from the General Assembly, which will provide objectivity and transparency, and the pricing will be determined in an equally objective and transparent way.
7. Within the framework of approved grid modernization projects, electric utilities will have exclusive control for the scope, scheduling, and execution of projects to install, maintain, and repair fiber assets, including fiber route selection and build/splice schedules.
8. Electric utilities have control of the method of attachment and connection to distribution and fiber assets.
9. Electric utilities will manage and document the entities that lease fibers in order to manage operations, including outage notification and management.
10. Establish financial incentives for last-mile developers, municipal broadband authorities, and service providers to lease government or utility middle-mile assets.

Appendix A: Summary of External Outreach Efforts

For added perspective, APCo met with local officials, state organizations, electric utility peers, internet service providers, wireless carriers, and others with an interest in expanding and improving broadband services. The team also reviewed broadband feasibility studies from across the country to expand and validate knowledge of various challenges and solutions to broadband expansion. Outreach efforts and resources reviewed include the following:

Outreach

ALBEMARLE COUNTY

AMHERST COUNTY

BEDFORD COUNTY

BLAND COUNTY

BLUE RIDGE CROSSROADS ECONOMIC DEV. AUTHORITY

BOTETOURT COUNTY

BUCHANAN COUNTY

CARROLL COUNTY

CENTRAL VIRGINIA ELECTRIC CO-OP

CHIEF BROADBAND ADVISOR TO THE GOVERNOR

COMCAST

COX COMMUNICATIONS

CRAIG BOTETOURT ELECTRIC CO-OP

CRAIG COUNTY

DICKENSON COUNTY

DOMINION

EXECUTIVE DIRECTOR, VIRGINIA TOBACCO COMMISSION

FLOYD COUNTY

FRANKLIN COUNTY

GALAX CITY

GILES COUNTY

GRAYSON COUNTY

HENRY COUNTY

NELSON COUNTY

PATRICK COUNTY

PITTSYLVANIA COUNTY

ROANOKE CITY

ROANOKE COUNTY

RUSSELL COUNTY

SALEM CITY

STATE CORPORATION COMMISSION STAFF

SUNSET DIGITAL

VERIZON

VIRGINIA CABLE TELECOMMUNICATIONS ASSOCIATION

VIRGINIA DEPARTMENT OF TRANSPORTATION

WASHINGTON COUNTY

WYTHE COUNTY

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