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In the interest of bringing high-speed broadband access to communities underserved by current Internet service providers, many U.S. cities have initiated municipal broadband projects. Such efforts have received favorable attention from those eager to help close the digital divide. This brief presents a first look at a new, comprehensive empirical analysis of 20 U.S. municipal fiber builds for which financial data is available. The findings show that half of the projects in this study are cash-flow negative, and based on their performance from 2010-2014, 90 percent are unable to generate sufficient cash to recover their project costs within the 30-40 year life expectancy of a municipal fiber build. City leaders considering such projects, as well as state and federal officials interested in supporting them, need to understand the documented costs and risks before encouraging new municipal fiber programs to form.

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Over the last several years, municipal broadband service provided via fiber to the home (FTTH) has attracted significant attention from industry analysts, policy advocates, and the media.

News stories have pointed to FTTH projects in places like Chattanooga, TN, as success models that other cities should follow. In February 2015, the Federal Communications Commission attempted to open the door to more widespread use of municipal fiber by preempting state laws blocking cities from investing in broadband, only to see its efforts overturned by the courts the following year. Other countries have shown similar interest in constructing public fiber networks. In Europe, press reports calling for Gigabit broadband have led countries such as Germany and Great Britain to consider devoting resources from their Universal Service Funds to FTTH rollouts. The Australian government has invested US$36 billion to deploy fiber to its citizens through its National Broadband Network (NBN).

At the same time, the fate of some fiber projects has provided reason for caution. Several promising U.S. projects bled substantial amounts of red ink before they were sold to private companies for a fraction of their costs.[1] Other municipalities, including Burlington, VT, and Monticello, MN, have defaulted on the debt they incurred to fund their fiber networks and now face credit downgrades. Google Fiber has

SUMMARY

- In the interest of bringing high-speed broadband access to communities underserved by current Internet service providers, many U.S. cities have initiated municipal broadband projects. Such efforts have received favorable attention in the media, as well as support from many state and federal lawmakers and regulators eager to help close the digital divide.
- But is municipal broadband economically viable? There has been a dearth of concrete data for answering that question. This brief presents a first look at a new, comprehensive empirical analysis of 20 U.S. municipal fiber builds for which financial data is available.
- The findings provide considerable reason for caution. More than half of the projects in this study are cash-flow negative, and based on their performance from 2010-2014, 90 percent are unable to generate sufficient cash to recover their project costs within the 30-40 year life expectancy of a municipal fiber build.
- City leaders considering such projects, as well as state and federal officials interested in supporting them, need to understand the documented costs and risks before encouraging new municipal fiber programs to form.

halted further rollouts in new cities. And looking abroad, in 2013, prohibitive costs forced Australia to abandon further expansion of its ambitious FTTH initiative in favor of an approach providing new service through a mix of legacy technologies.

The debate between advocates and critics of municipal fiber has been hampered by the dearth of hard data on existing projects. This Issue Brief highlights the key takeaways from a comprehensive study of municipal fiber operations in the U.S. The core of the analysis is based on an empirical assessment of every U.S. municipal fiber build, applying the standard tools of financial analysis to data drawn from the official bond documents issued when the projects were launched and from the audited financial statements filed by these projects during a five-year period (2010-2014). In so doing, this research represents the first systematic effort to place the debate over municipal fiber on a sound empirical foundation.

THE CURRENT FTTH LANDSCAPE

The Executive Office of the President's January 2015 report on *Community-Based Broadband Solutions* as well as trade and scholarly publications indicate that 88 local governments have deployed FTTH.[2] Of these projects, only 20 reported the results of their broadband operations separately in their audited financial statements, with the others opting to combine their broadband and electric power operations into a single set of financial statements.[3]

The audited financial statements provide data about the annual cash flows for all 20 of the projects that reported the financial performance of their broadband operations separately. A review of the bond instruments filed with the Municipal Securities Rulemaking Board (MSRB) provides the project cost and cost of capital for 13 of the 20 projects. For the remaining seven projects, we estimated project cost and cost of capital by using the median values of the 13 projects for which we have data, which yielded a project cost per household of $2,215 (normalized for 2010 dollars) and a cost of capital of 5.11%. The project cost data compare unfavorably to the $750 estimated cost per household of Verizon's FiOS project and are much closer to the roughly $3,000 per household figure that eventually led Australia to walk away from its FTTH builds. Note that the project cost data do not include any federal or state subsidies that municipalities may have received.

The cities with municipal fiber appear to be broadly representative of the overall U.S. population, but the median household income of $41,527 is below the 2014 national median of $53,657. The data suggest that high median household income is no guarantee of a network's solvency, as the only municipality in this study with a median household income above the national median (Monticello) has already defaulted on its FTTH debt obligations. These data permit us to assess the likelihood that these projects will be able to cover their costs through the standard tool used by the investment community to evaluate projects' financial viability: Discounted Cash Flows (DCFs).

MUNICIPAL FIBER'S FINANCIAL PERFORMANCE: A LOOK AT CASH FLOWS

The financial community universally regards cash flow as more important than profitability, since it is cash flow (and not income) that determines whether an organization remains solvent. Discounting the cash flows takes into account the cost of financing as well as the time value of money.

DCF analysis indicates that 11 of the 20 municipal projects were cash flow negative from 2010 to 2014, many of them substantially so. (See Table 1 for full results.) Unless these

NOTES

1 These include Marietta, GA (1996-2004); Provo, UT (2004-2008); Quincy, FL (2004-13); Dunellon, FL (2011-13); and Bristol, VA (2003-2016).

2 Other sources include FTTH Council (2009) and Montagne and Chaillou (2010). Of these, two projects spanned multiple cities (the Electric Power Board of Chattanooga and the Utah Open Infrastructure Agency (UTOPIA)), and another was initiated by a county (Churchill County, NV).

3 The fact that less than a quarter of U.S. municipal fiber builds reported their broadband operations separately does raise the possibility of sample bias. One possible motivation for combining operations into a single set of financial statements is to conceal a broadband operation's poor performance. To the extent this is true, the results of our analysis are biased in favor of making municipal fiber appear more successful than would be the case had all of these projects reported their data separately. If so, our results should be regarded as a best-case scenario for municipal fiber.

4 Caveat: the relatively small number of observations limits the statistical significance of these regressions.

eleven fiber projects substantially improve their performance, they will soon have to consider whether their citizens would be better off if they ceased operations. Of the nine remaining projects, five would require over a century at current rates to recover the cost of their projects (Pulaski, TN; Tullahoma, TN; Chattanooga, TN; Powell, WY; and Brookings, SD). The DCF analysis of Chattanooga – the municipal fiber project most often held up as a role model – reveals it would take 412 years to break even at the performance levels achieved from 2010 to 2014. Two other projects would require over 60 years (Fayetteville, TN; and Windom, MN). Such results are problematic when the useful life of a fiber network is usually estimated to be 30 to 40 years.

The data identify two potential success stories. If Bristol, TN, were to maintain the results it achieved from 2010 to 2014, its project would break even after 34 years of operation. That said, Bristol did not begin offering fiber until 2012. That means that the inclusion in the analysis of the stronger results for 2010 and 2011, when Bristol was offering only DSL service, may not be representative of the likely long-run performance of its fiber operations.

Our analysis also suggests that Vernon, CA, recovered its estimated project costs after only two years of operation, but the reasons for this quick turnaround limit Vernon's usefulness as a model for other projects. Vernon is a small city outside of Los Angeles and home to only about 100 residents, but over 1,800 businesses. The municipality is thus almost entirely comprised of commercial enterprises. This means that for Vernon, estimating project cost on a per-household basis probably substantially understates its actual costs. Indeed, the City's audited balance sheet indicates that the project cost was $3 million as

TABLE 1: RESULTS FROM THE DISCOUNTED CASH FLOW ANALYSIS

Municipality	Age of Project as of 2010	Adjusted Project Cost (2010 dollars)	Project Cost per Household	Total Discounted Cash Flows, 2010-14	Years for Project to Turn Positive	Annual Rate of Revenue Growth
Full Data Available:						
Fayetteville, TN	10	-$14,039,772	$4,237	$1,141,877	61	4.53%
UTOPIA, UT	8	-$224,877,300	$1,547	-$7,188,982	never	16.77%
Kutztown, PA	8	-$7,050,207	$3,412	-$1,748,722	never	3.10%
Windom, MN	6	-$10,963,025	$4,709	$838,936	65	9.86%
Pulaski, TN	5	-$9,602,904	$2,425	$97,948	490	10.30%
Burlington, VT	4	-$36,383,199	$2,139	-$10,605,688	never	0.68%
Lafayette, LA	3	-$118,789,745	$2,215	-$36,086,333	never	35.94%
Tullahoma, TN	3	-$18,264,172	$2,053	$846,549	108	20.13%
Clarksville, TN	3	-$43,253,003	$765	-$7,442,513	never	23.65%
Chattanooga, TN	2	-$170,101,635	$1,099	$2,062,787	412	41.08%
Monticello, MN	2	-$27,767,517	$5,549	-$25,508,327	never	34.86%
Wilson, NC	2	-$30,649,795	$1,417	-$2,900,201	never	10.12%
Salisbury, NC	2	-$31,500,303	$2,224	-$1,702,339	never	103.82%
Project Cost and Cost of Capital Estimated:						
Churchill County, NV	6	-$24,893,781	$2,215 (est.)	-$470,833	never	-2.39%
Vernon, CA	5	-$59,390	$2,215 (est.)	$156,602*	2	16.63%
Loma Linda, CA	5	-$22,064,618	$2,215 (est.)	-$2,445,825	never	10.32%
Bristol, TN	5	-$28,692,715	$2,215 (est.)	$4,168,048	34	19.22%
Morristown, TN	4	-$28,779,887	$2,215 (est.)	-$4,281,017	never	8.28%
Brookings, SD	4	-$20,252,,935	$2,215 (est.)	$290,521	349	4.27%
Powell, WY	3	-$6,225,980	$2,215 (est.)	$24,847	1,253	14.88%
High	10	-$59,390	$5,549	$4,168,048	1,253	103.82%
Low	2	-$224,877,300	$765	-$36,086,333	never	-2.39%
Median	4	-$26,299,149	$2,215	-$1,086,586	108	10.32%
Standard Deviation	2.2	$57,141,294	$1,143	$9,549,916	375	22.06%

of 2006, which would imply a payback period of 110 years. In any event, Vernon's commercial focus makes its FTTH build atypical and an inapt model for cities considering projects that are primarily residential.

IMPLICATIONS FOR FUTURE FTTH PROJECTS

The data permit us to construct two different estimates of how any hypothetical project might perform. The first approach uses the actual returns achieved on a per-household basis by the projects we are studying to estimate how a future project might perform during the 14-year period for which we have data (excluding Vernon, because its commercial focus limits its usefulness for a per-household analysis). These data suggest that during its first 14 years, a hypothetical project would have an aggregate loss of -$705 per household. Adding this to the average adjusted project cost per household of $2,215 yields a total cost of FTTH operations of -$2,920 per household over its first 14 years.

The second approach employs regression analysis on the data to construct a model that extrapolates the financial performance of a hypothetical project beyond the 14 years for which we have data.[4] Depending on the type of regression employed, the model estimates that a project would take from 81 to 318 years to break even. A separate regression allows us to explore whether these poor results are the result of weak revenue from attracting too few subscribers (measured by revenue/household), inefficient operations (measured by operating cost/operating revenue), or from capital expenses that are too high (measured project cost/household). Statistically, the specifications including Vernon identify revenue per household as the statistically significant factor, while some of the specifications excluding Vernon indicate that operating efficiency is the key driver. Together these results suggest that marketing and operating expenses (opex) play more critical roles in the success of a municipal fiber project than capital expenses (capex).

Case studies of seven high-profile projects provide additional insight into the challenges that municipal fiber projects face in generating positive cash flows. Returning to Chattanooga, the Electric Power Board (EPB) began offering broadband service in 2009. By 2014, it was earning more than $1,200 per household in annual revenue. This compares favorably with the $446 in annual revenue per household achieved by all of the municipalities in this study. However, its annual positive cash flow during the five-year period from 2010 to 2014 of roughly $400,000 is dwarfed by the $162 million in bond indebtedness EPB undertook to finance this venture. This analysis does not even consider the initial $50 million loan from the EPB's electric power operations used to launch the project or the non-replicable $111.5 million in federal stimulus funding that EPB received from the Department of Energy. The addition of stimulus funding to the analysis increases the break-even period from 412 to 683 years. It bears noting that the financial performance of some of these projects may improve, and the high-level analysis may overlook key details that can help explain the results in particular cases. That said, the overall analysis provides a useful snapshot of the challenges that municipal fiber projects face.

LESSONS FOR PUBLIC OFFICIALS

Debates over municipal fiber have been long on rhetoric and short on empirical analysis. This Issue Brief attempts to fill that void and provide cities weighing whether or not to initiate a municipal fiber project with concrete data on which to base their decisions. The overall dataset provides considerable reason for caution—not just on the part of city leaders, but also lawmakers and regulators at the state and federal levels who have viewed municipal broadband as an economically viable tool for closing the digital divide. More than half of the projects in this study are cash-flow negative, and 90 percent are unable to generate sufficient cash during the period studied to recover their project costs within the life expectancy of these assets, which is between 30 and 40 years.

A closer examination of specific projects reveals that the risks and consequences are quite real. Many cities managing these projects have faced defaults, reductions in bond ratings, and ongoing liability that prevented them from undertaking other initiatives and exacted a toll on city leaders in terms of personal turmoil and distraction from other matters important to citizens. City leaders should carefully assess all of these costs and risks in light of their own situations before permitting a municipal fiber program to go forward.

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Christopher Yoo has emerged as one of the nation's leading authorities on law and technology. His research focuses on the insights that the principles of network engineering and imperfect competition provide into the regulation of electronic communications. He is building an innovative integrated interdisciplinary program designed to produce a new generation of professionals with joint degrees in both law and engineering. His major research initiatives include a study of innovative approaches to connecting more of the world's citizens to the Internet, an exploration of the legal aspects of providing privacy and security for autonomous vehicles and medical devices, and a comparison of competition law in China, Europe, and the U.S. Yoo testifies frequently before Congress, the Federal Communications Commission, and the Federal Trade Commission. Before joining the academy, Yoo clerked for Judge A. Raymond Randolph of the U.S. Court of Appeals for the D.C. Circuit and for Justice Anthony M. Kennedy of the Supreme Court of the U.S.

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Timothy Pfenninger recently completed his JD at the University of Pennsylvania School of Law, where he served as a research assistant for Professor Christopher Yoo and was on the editorial board of the University of Pennsylvania *Journal of Business Law*. He also earned a Certificate in Management from the Wharton School at Penn. In the fall, he will serve as a Law Clerk to Judge A. Richard Caputo of the U.S. District Court for the Middle District of Pennsylvania.

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