From Gig City to Quantum City: The Value of Fiber Optic Infrastructure in Hamilton County, TN 2011-2035

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With

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EXECUTIVE SUMMARY

This study computes the realized economic value of fiber optic infrastructure in Hamilton County and the city of Chattanooga over a 15-year period from 2011 to 2025. Our estimates show that the economic value of high-speed broadband and the smart grid exceeds $5.3 billion and 10,420 jobs over the study period as seen in **Table A**. The incremental value of the infrastructure exceeds the cost by a factor of 6.4x. Each county resident is estimated to have benefited by about $936 per year due to the incremental value generated by the fiber optic infrastructure. These estimates exceed the projections made at the time the infrastructure was planned, and in subsequent efforts to measure the realized value of the infrastructure.

Table A. Summary of Realized Benefits of Fiber Infrastructure 2011 - 2025		
Source	**$ Millions**	**% of total**
High-speed broadband contribution	$3,727.7	69.9
Smart grid savings	$1,094.0	20.5
Residential bill savings	$332.2	6.2
Consumer surplus due to high-speed broadband	$98.1	1.8
Media coverage of fiber infrastructure	$82.1	1.5
Total Value to the Community ($Million)	$5,334	
Total Jobs	10,420	
Incremental Value-to-Cost ratio	6.4x	

The benefits of the infrastructure are seen not only in events that did not happen such as broadband buffering, electric outages or avoided electric rate hikes, but also in business efficiencies, time and money saved, potential unlocked, and the price and quantity effects of competition. The benefits also show up in helping place Chattanooga "on the map" via media exposure, which in turn, helps to draw businesses and talent to the area.

Over the next ten years, we estimate that the fiber infrastructure, which supports high-speed classical broadband, the smart grid, and the nation's first commercial quantum network, is likely to generate between $4.7 billion and $5.1 billion in economic value for the Chattanooga region. In addition, we expect the infrastructure will be responsible for 7,700 to 9,000 jobs in the region as seen in **Table B**.

Table B. Summary of Expected Benefits of Fiber Infrastructure: 2026 - 2035	
High-speed Broadband ($Million)	$3,044
Smart Grid ($Million)	$995
Quantum Initiative ($Million)	$688 – $1,110
Total Value ($Million)	$4,726 – $5,148
Total Jobs	7,708 – 9,070

Fiber networks are poised to be the backbone for a host of revolutionary technologies and services in the coming decade. Chattanooga appears ready to meet these new developments. By 2035, it is likely that the moniker "*Quantum City*" will apply.

CHAPTER 1. INTRODUCTION

1.1 Scope and methodology

This study seeks to extend the analysis in Lobo (2015, 2020) in computing the realized economic value of fiber optic infrastructure in Hamilton County and the city of Chattanooga, over a 15-year period from 2011 to 2025. The analysis addresses the broad research question: *What have been the incremental effects of high-speed broadband and the smart grid in Hamilton County TN*?

Methodologically, our approach has been to initially review the academic/scientific literature for work relevant to this study and then to trace the local effects with local data and case studies. We then conducted numerous interviews with individuals in the community to gauge their uses of this infrastructure and their perceptions of value. We discover that the benefits of the infrastructure are manifest in events that *did not* happen such as broadband buffering or electric outages or electric rate hikes. Benefits also show up in business efficiencies, time and money saved, potential unlocked, and the price and quantity effects of competition. Often, the benefits show up in helping place Chattanooga "on the map" via media exposure, which, in turn, helps to draw businesses and talent to the area. The development of metrics for such a study is challenging. In this study, we adopt a hybrid approach that relies both on analytical as well as model-based estimates in conjunction with concepts such as consumer surplus to get to the true incremental value of the fiber infrastructure.

Infrastructure: *noun*

- *the basic physical and organizational structures and facilities (e.g. buildings, roads, power supplies) needed for the operation of a society or enterprise. [Oxford English Dictionary]*

- *the basic systems and services that are needed in order to support an economy, for example, transport and communication systems and electricity and water supplies. [Cambridge English Dictionary]*

1.2 Do we need fiber optic infrastructure?

In Chattanooga and Hamilton County, fiber optic infrastructure has primarily been responsible for a smart electric grid and community-wide high-speed broadband internet access. Do we need fiber optic infrastructure for broadband access and a smart grid? The short answer is, yes. Fiber optics provide far greater bandwidth and speed compared to copper or wireless alternatives. This is crucial for modern internet use (e.g., streaming, video calls, cloud apps) with over 30 devices per household, on average. Fiber enables lower latency, which improves real-time services like online gaming and telemedicine, and can be upgraded by simply changing the electronics at the ends, without replacing the cables, making it future proof. Smart grids rely on fast, reliable, two-way communication between utilities and infrastructure (e.g., meters, sensors, substations). They generate large volumes of data that need high-speed transport to and from central systems. Fiber is less susceptible to electromagnetic interference and is harder to tap, making it more secure and stable for critical infrastructure. The bottom line: You don't *absolutely* need fiber for every broadband or smart grid application, but it is a foundational technology for delivering high-performance, scalable, and future-proof infrastructure, especially in urban and industrialized areas.

It has a very low marginal cost for increasing bandwidth (e.g., switching optics or updating router capacity). It is this infrastructure that will position EPB and Chattanooga to offer a robust quantum network in the years ahead.

The buzz today surrounds the widespread use of generative Artificial Intelligence (AI). As one practitioner put it, "*…Hyperscalers in the tech industry are hungry for substantial fiber capacity to fuel AI and cloud computing. The demand for AI models is spurring data center expansions and high-capacity fiber connections, marking a pivotal moment in the telecom landscape.*" Indeed, AI applications require real-time or near-real-time processing, requiring low latency and network support for accelerating these applications. Even as we attempt to understand the myriad AI-machine learning effects, quantum technology (QT) is evolving in parallel. QT is expected to supplement or even supplant classical computing for certain applications. While the science, hardware and software are likely to be very different, both classical and quantum computing require a robust high-bandwidth, low-latency fiber infrastructure.

In 2020, the Covid-19 pandemic resulted in a major shift in work norms and the disruption of schooling. It drew attention to "last mile" connectivity to people's homes and led a Brookings Metro's COVID-19 Analysis to conclude that the pandemic "*…isn't making broadband essential, it is exposing that it always was.*" Working from home and teleconferencing, telehealth, voting by mail or online, digitally shopping for groceries, distance learning, etc. require robust, reliable and speedy internet connectivity. People, businesses, and devices have all become data factories that are pumping out incredible amounts of information to the web each day (Lobo, 2020). As the average household daily usage of broadband jumped in the wake of the pandemic, the use of upstream broadband - used for video conferencing and calling - increased at a faster clip overall than the more traditional internet activities such as streaming and gaming, i.e. downstream internet usage. By 2025, it was estimated that 463 exabytes of data would be created each day globally (see **Appendix I and II**). For every second of the day, there is 88,555 GB of internet traffic. It is clear that high-speed symmetrical broadband is a minimum requirement to harness this data. It is essential, not a luxury.

The internet continues to transform how we connect with others, organize the flow of information, and share opinions. Statista reports that in 2025 the number of internet users worldwide stood at 5.56 billion, which means that around two-thirds of the global population is currently connected to the world wide web.

1.3 The history of fiber optic infrastructure in Hamilton County, TN

Fiber optic infrastructure was brought to Chattanooga and Hamilton County, TN residents in 2009 by EPB, the local electric utility. EPB was created by the Tennessee legislature in 1935 as a nonprofit municipal utility owned by the City of Chattanooga. EPB operates in a 600-square-mile service area and is governed by an (5-person) independent board of directors.[1] While primarily a distributor for the Tennessee Valley Authority (TVA), EPB also generates 6 MW in electricity with a target of generating 150 MW of energy storage capacity by 2028.

[1] Roughly 81 percent of all public utilities listed as regular members of the TVPPA members have independent boards, while 19 percent are run by their City Council. Of the 103 municipal members, 74 (72 percent) have independent boards and 29 are governed by city council. None of the City Council-run Muni's offers internet or fiber service, although some are listed as offering a smart grid and several also provide water to their communities.

EPB's mission is "*to enhance the quality of life in our community by providing energy, communications and related services reliably, efficiently, and courteously at the best possible value*."

The fiber optic build out cost $396.1 million (Lobo, 2020). The infrastructure was used to build a smart electric grid and to bring community-wide high-speed broadband to homes and businesses in the EPB footprint. In September 2010, EPB made available residential symmetrical gigabit speed internet - the fastest internet in the western hemisphere at the time and the "gig city" moniker began to be applied to Chattanooga. By 2013, the smart grid became fully operational. In 2015, EPB made 10 gigabit internet service available to every home and business in its 600 square mile service area. [2]

Additionally, EPB's Broadband Solutions initiative was created in 2012 to work with communities across the nation to help them successfully deploy and manage broadband networks. Currently, EPB Broadband Solutions has established contracts to support 34 out-of-market fiber optic providers and ISPs that have more than 160,000 subscribers and the potential to serve as many as 985,000 homes and businesses in communities all over the country. Broadband Solutions also works with 36 providers operating inside EPB's footprint to deliver various services, including 24/7 technical support for residential and business customers. For the 2025 fiscal year, this group has generated in excess of $9.1 million in revenue.

The inaugural U.S. Broadband Awards hosted by Questex's Fierce Telecom named EPB Best Municipal Connectivity Program in 2023. The winners were selected by a panel of 20 judges based on effectiveness, technical innovation, financial and community impact, individual efforts in driving broadband investment and true innovation in addressing the digital divide.

In 2024, J.D. Power ranked EPB as the #1 mid-sized electric utility in the South for customer satisfaction for the ninth year in a row. This recognition was based on customer feedback regarding trust, reputation, and marketing execution. Additionally, Consumer Reports named EPB the #2 Internet Provider in the country with 5 out of 5 ratings for Value, Reliability, Speed and Technical Support.

1.4 Organizing Framework

This study is organized as follows. Chapter 2 presents a profile of Hamilton County, TN, which makes up about 90 percent of the EPB fiber optic footprint. Chapter 3 breaks out the benefit to the community of the fiber infrastructure. Relative to previous studies, we take a hybrid approach comprising analytical estimates as well as estimates from an input-output model. Chapter 4 describes the smart grid savings in detail. Chapter 5 explores various pockets of the community that are particularly impacted by the fiber infrastructure using the National Telecommunications and Information Administration (NTIA) framework. Chapter 6 delves into the new quantum initiatives in Chattanooga built on the back of the fiber optic network. Chapter 7 concludes with a 10-year look ahead to the likely value of the fiber infrastructure by 2035.

[2] For more on the backstory behind EPB's fiber build out, see the 2013 Harvard Business School case study N9-313-097 titled, "EPB: Energizing Chattanooga."

1.5 Milestones relevant to this study

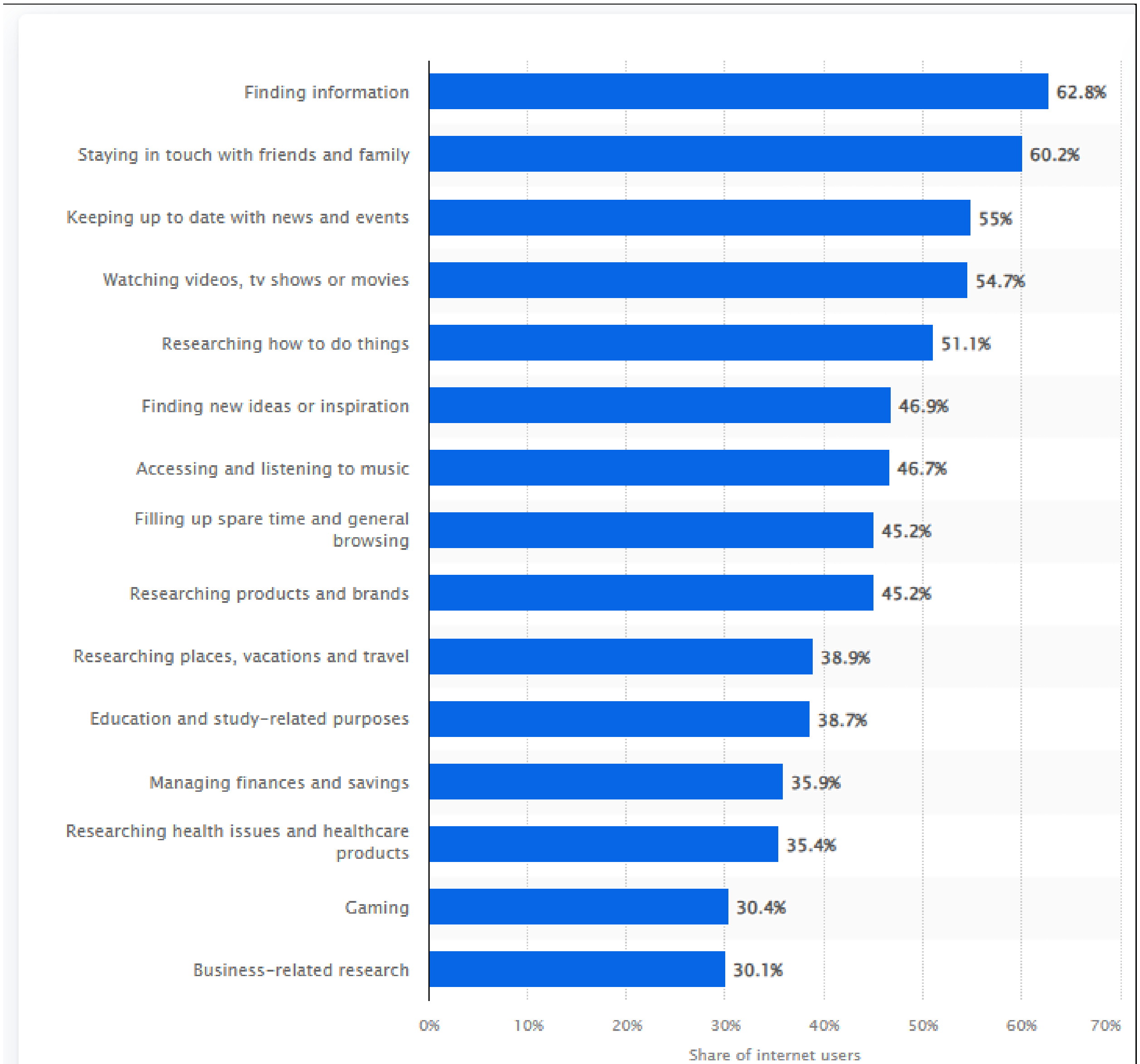
- In 1939, EPB became the provider of electricity in Chattanooga, Hamilton County and other surrounding counties.
- In 2000, EPB Telecom was launched to provide telecommunication service for local businesses.
- In 2008, EPB made a 25-year $230 million bond offering to begin construction of its Smart Grid and enter the TV/internet business.
- In 2009, EPB received a one-time matching $111 million ARRA grant.
- In 2010, EPB began offering residential gig speed internet access.
- In 2011, the fiber optic buildout was completed.
- In 2012, EPB launched Broadband Solutions to help communities across the nation successfully deploy and manage broadband networks
- In 2013, EPB completed the installation of Smart Meters in all homes and businesses.
- In 2014, EPB, DOE and ORNL announced a partnership to make the smart grid a living lab for new energy technologies.
- In 2015, EPB launched a community-wide 10 gig internet service.
- In 2019, EPB upgraded base tier broadband service from 100 Mbps to 300 Mbps at no cost to the customer; EPB also lowered the price of gig service by $2/month.
- In 2020, EPB, the Los Alamos National Lab and ORNL tested the Cybersecurity for Energy Delivery Systems using quantum technology.
- In 2022, EPB launched a community-wide 25 gig internet service.
- In 2022, EPB launched EPB Quantum Network^{SM} powered by Qubitekk to accelerate the commercialization of quantum technologies.
- In 2024, EPB reorganized into two business units: energy and communication, and strategic initiatives.
- In 2025, EPB announced a new partnership with IonQ to add a quantum computer and commercial quantum network.

In FY 2024, EPB provided electricity to over 198,000 customers and broadband internet service to approximately 122,000 customers in its footprint. The fiber optics division contributed about 23 percent of total EPB revenues and 16 percent of operating expenses.[3] EPB is the largest contributor to local taxes making payments-in-lieu-of-taxes (PILOT) to the City of Chattanooga, Hamilton County, and other local governments in excess of $20 million in FY 2024.

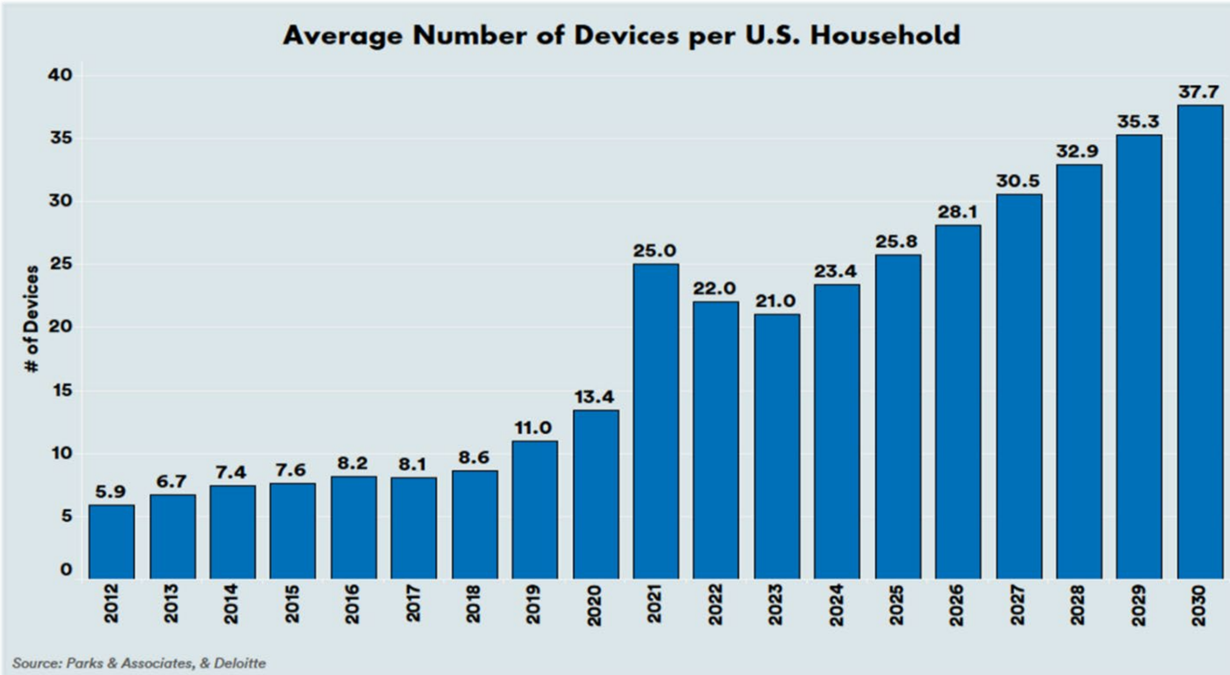
[3] Excluding depreciation & amortization and tax equivalents

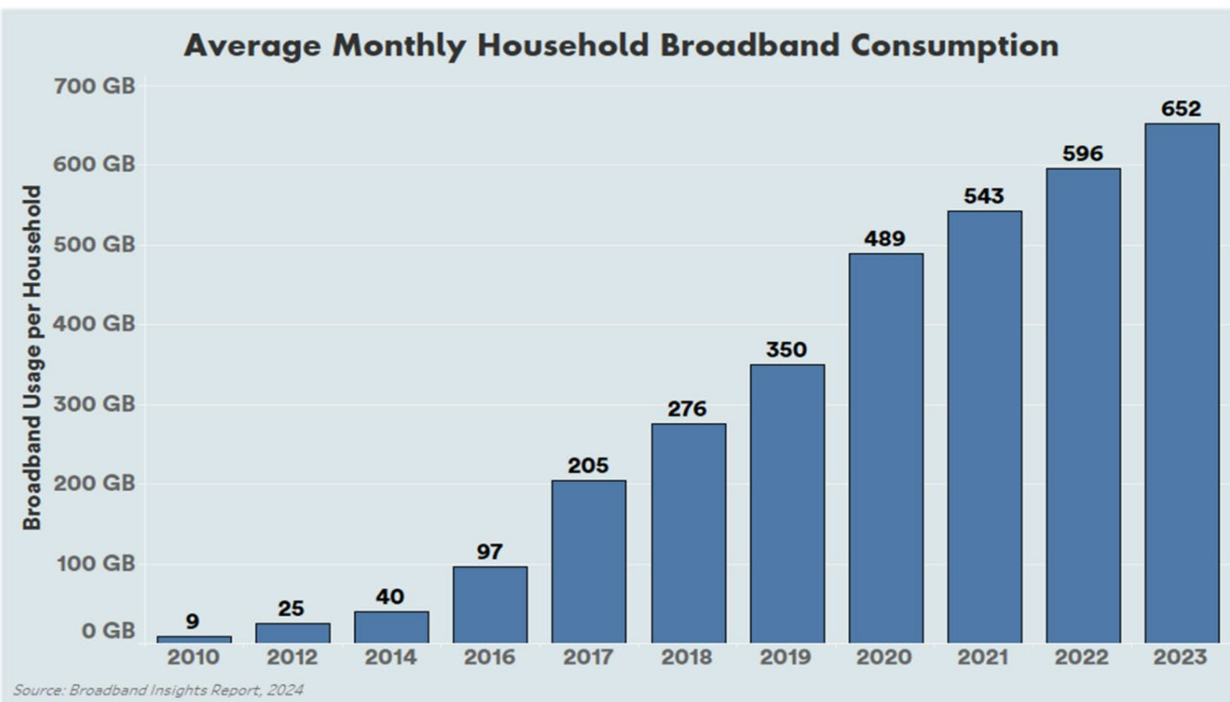
Appendix 1. How do people use the internet?

Statista 2025: 3rd quarter 2024



Appendix 2. Household Broadband Consumption





CHAPTER 2. HAMILTON COUNTY, TN

2.1 Demographic Profile

Hamilton County is the fourth largest county in the state of Tennessee based on population. As seen in **Table 2.1**, by July 2023, it had a population of 379,864, up 12.9 percent from 2010. Growth in the wake of the Covid-19 pandemic was higher than for the state and rest of the country. The county is 71.4 percent white, 16.4 percent black and 6.8 percent Hispanic. Since 2019, the percentage of residents that are Hispanic has risen, while the black population has fallen. Approximately 91 percent of the adult population in the county has at least a high school education or better, with 37 percent holding a bachelor's degree or better.

Table 2.1 Hamilton County Demographic Profile

	Hamilton County	Tennessee	USA
Population estimates (July 1, 2021- TN, USA) (July 1, 2023- Hamilton)	379,864	6,975,218	331,893,745
Population, percent change (April 1, 2020- July 1, 2023)	3.70%	3.10%	1.00%
Population per square mile (2020)	675.5	167.6	93.8
Population white alone, (2023)	76.3%	74.90%	65.90%
Language other than English spoken at home, percent of persons age 5 years+ (2018-2022)	8.20%	7.50%	21.70%
Persons 65 years and over (2022)	18.70%	16.70%	16.50%
Persons 18 years or under (2022)	21.10%	22.00%	22.10%
High school graduate or higher, percent of persons age 25+(2022)	91.1%	89.30%	89.10%
Bachelor's degree or higher, percent of persons 25+ (2022)	37.0%	29.70%	34.30%
Median gross monthly rent (2022)	$1,184	$1,096	$1,268
Households (2019-2023)	151,316	2,713,635	125,736,353
Persons per household (2019-2023)	2.39	2.50	3.18
Households with a computer (2018-2022)	94.7%	92.30%	94.00%
Households with broadband internet subscription (2022)	90.4%	85.70%	88.30%
Persons without health insurance, under age 65	11.80%	11.10%	9.30%
Median household income (in 2023 dollars) (2019-2023)	$72,568	$64,035	$75,149
Median hourly wage rate (May 2023) *	$20.75	$21.07	$23.11
Median value of owner-occupied housing units, 2023	$290,000	$282,400	$337,900
Mean travel time to work (minutes), workers age 16+ (2022)	21.9	25.5	26.7
Remote workers / telecommuters (2023)	12.9%	11.4%	13.5%

Source: U.S. Census: American Community Survey 2023: 5-year Estimates, * Chattanooga MSA

Since 2018, the median value of an owner-occupied housing unit has risen by 46 percent in the county. This outpaced the nation's growth of 37.5 percent over the same period. One factor playing a role in the rising value of these units is the increased demand for housing as in-migration has picked up. The city of Chattanooga is routinely named one of the top places in the U.S. to live. In April 2024, Money Magazine named Chattanooga one of the 50 best places to live in the United

States. Chattanooga mayor Tim Kelly remarked, "*This praise… comes on the heels of Chattanooga rising 26 spots in the Milken Institute's 'Best Performing Cities' ranking and Chattanooga being ranked first in Tennessee by moveBuddha for our ratio of inbound to outbound movers…*". In 2025, Chattanooga was named the first national "Park_City" in North America, adding to its attractiveness.

Data from the IRS shows not only have the number of migrants into the Chattanooga MSA increased but their average adjusted gross income (AGI) has sharply increased as well as seen in **Fig 2.1** below.

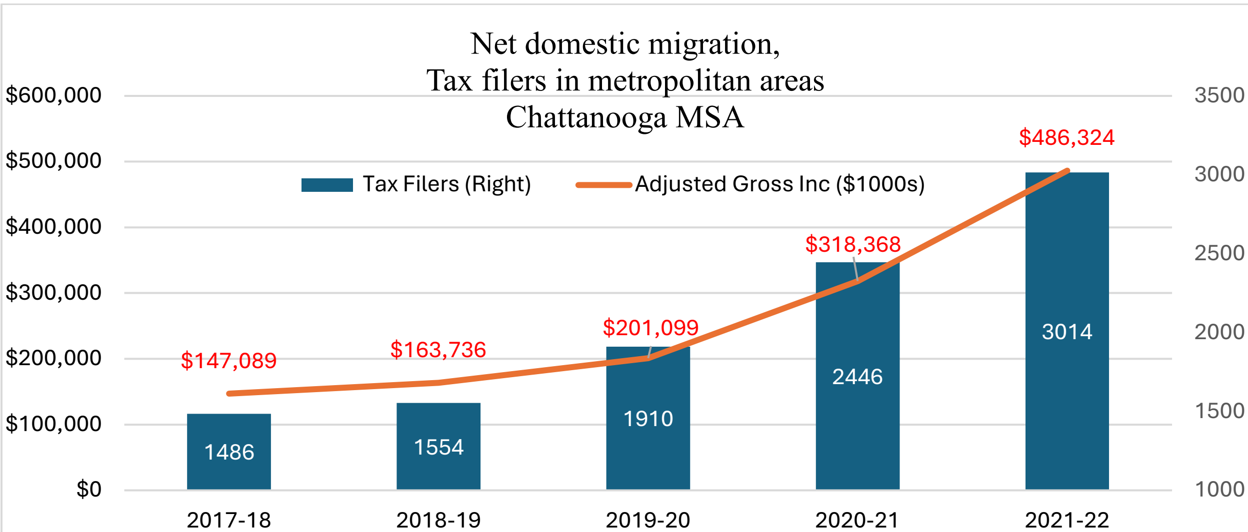


Fig. 2.1 Net Domestic Migration

The American Community Survey (ACS) shows that the work-from-home (WFH) percentage of employees in Chattanooga has more than doubled to about 13 percent in 2023 compared to 2019 (see **Fig. 2.2**). The uptrend in Chattanooga contrasts with the downtrend in the rest of the country. Chattanooga's citywide fiber network with symmetrical multi-gigabit internet speeds to homes and businesses enables people to more readily live and work in locations of their own choosing.

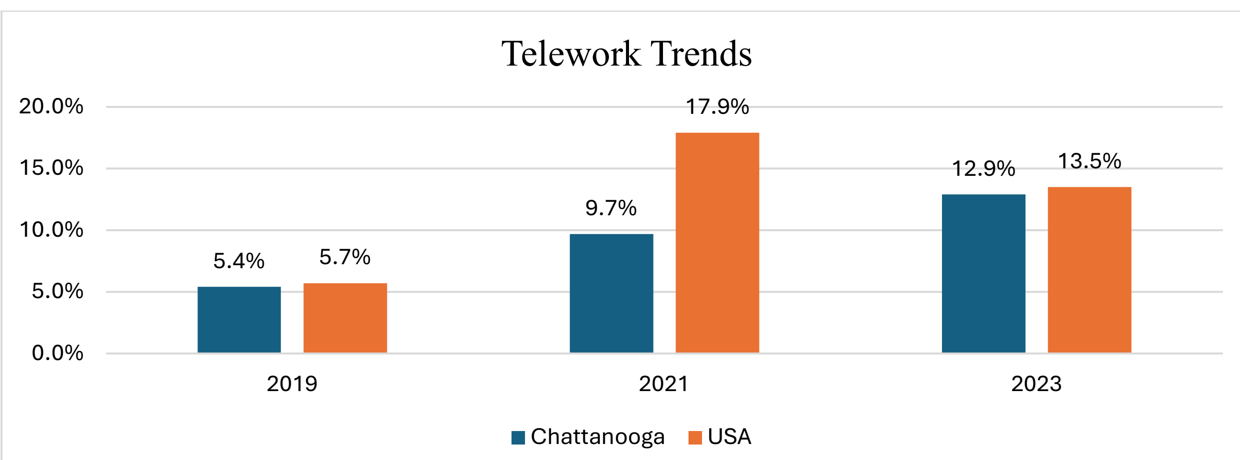


Fig. 2.2 Telework in Chattanooga v USA

2.2 Commercial Profile

Data from the Bureau of Labor Statistics (BLS) in **Table 2.2** shows that there were over 7,200 firms and 9,000 establishments in the county. Seventy-three percent of these firms are small businesses with fewer than 20 employees, roughly 16 percent have 100+ employees, and 12 percent have 500+ employees. The larger firms (100+ employees) support roughly 70 percent of county employment. With a labor force of 192,890, the employment rate was 96.5 percent in March 2020, *prior to the effects of COVID-19*, and around 96 percent by 2023.

Table 2.2 Hamilton County Business Profile

	Hamilton County	Tennessee	USA
All firms (2022)	7,201	96,206	5,535,295
Establishments (2022)	9,027	135,678	7,400,528
Civilian labor force (2023)	192,890	3,465,315	168,567,852
Total employment (2023)	184,845	3,301,152	159,808,535
Total annual payroll (2022) ($000)	$10,648,233	$146,851,899	$8,278,573,947
GDP (2022, in 2017 chained dollars)	$29.1 Billion	$412.1 Billion	$21.8 Trillion

Source: Census Table DP03 , Census Business Dynamics

The number of firms operating in the county has grown steadily outside of periods of economic downturns. For example, the dot-com bubble from 1998 to 2002 resulted in a 4 percent decline in firms. The largest decline was during the Great Financial Crisis (GFC) when active firms fell 5 percent. Most recently, the COVID pandemic saw firm counts fall 0.4 percent, before quickly rebounding in 2021.

Since the turn of the century, business dynamics have shifted across Hamilton County. In 2000 retail trade represented 14.8 percent of all firms in operation, the most of any industry. By 2021, the sector's share had fallen to 12.8 percent but remained at the top. Accommodation and food services experienced a rise in firm activity as the Chattanooga region has attracted tourists. The sector represented 9 percent of firms in 2021, up from 6.3 percent in 2000. The industrial and occupational structure of the County is shown in **Table 2.3**.

Table 2.3 Hamilton County Employment by Industry & Occupation

	Hamilton County	Tennessee	USA
Industry	**% of Total**		
Educational services, health care and social assistance*	22.5%	22.3%	23.3%
Manufacturing	13.0%	12.9%	10.0%
Retail trade	10.3%	11.7%	11.0%
Arts, entertainment and recreation, and accommodation and food services	9.6%	9.2%	9.0%

Professional, scientific, and management, and administrative and waste management services*	10.1%	10.3%	12.1%
Finance and insurance, and real estate and rental and leasing*	9.0%	6.1%	6.7%
Transportation and warehousing, and utilities	7.3%	7.0%	5.8%
Construction	6.1%	6.8%	6.9%
Other services, except public administration	5.2%	4.8%	4.7%
Public administration	3.1%	4.2%	4.7%
Wholesale trade*	2.3%	2.4%	2.4%
Information*	1.1%	1.6%	1.9%
Agriculture, forestry, fishing and hunting, and mining	0.5%	0.9%	1.6%
Occupations	**% of Total**		
Management, business, science, and arts occupations*	41.6%	37.7%	41.0%
Service occupations*	15.8%	15.8%	16.8%
Sales and office occupations*	21.2%	21.2%	20.5%
Natural resources, construction, and maintenance occupations	6.9%	8.6%	8.7%
Production, transportation, and material moving occupations	14.4%	16.7%	13.1%
Source: U.S. Census 2022; * are industries and occupations where at least 50% of all jobs can be done from home based on Tables 1 and 3 from Dingel and Neiman (June 19, 2020)			

Health care and social assistance have become the top sector in terms of employment due primarily to the shifting age dynamics in the county. In 2010, just under 18 percent of the population in the county was over the age of 60. By 2023, that percentage has risen to 24.7 percent. With almost a quarter of the local population reaching retirement age or higher, the need for health care increases. The county reflects the national and global trends of an aging population.

Almost 75 percent of employment in the county is attributable to six industries: Educational and health services, manufacturing, retail trade, accommodation and food services, professional and business services, and finance and insurance. When compared to the nation, Hamilton County has a larger fraction of employment in manufacturing, finance and insurance, and transportation and utilities. The county also has a lower fraction in the professional and business services, public administration and agriculture sectors.

A March 2024 white paper (WP) from **The Center for Regional Economic Research (CRER)** at UTC points out that "*Over the past decade, the Chattanooga economy has undergone a manufacturing-led resurgence and has experienced job growth that has been significantly higher than the national average… This recent resurgence is in contrast with the overall performance of the Chattanooga economy since 1990*." The CRER reports that the manufacturing sector in Chattanooga has not simply recovered lost jobs. It has been transformed from producing nondurable goods such as food to durable goods such as cars. The entry of Volkswagen and other durable-goods manufacturers into the Chattanooga economy has meant that the increase in manufacturing jobs in Chattanooga can be attributed to the expansion of durable goods manufacturing. "*And these are not at all like the manufacturing jobs of the past. They make much greater use of technology and require more skills and education than those in the old smokestack factories*." (CRER WP No. 1) This manufacturing-led boom in employment growth *"…has meant* *higher employment to population ratios for every major demographic category, despite the major disruption of the COVID pandemic… The biggest gains were experienced by those aged 20 to 44, men, African Americans, and those with a college degree or high school diploma as their highest education."* (CRER WP No. 5)

The primary city in the county is Chattanooga, with a population of about 182,832; the Metropolitan Statistical Area (MSA) has a population of 569,333. Variously called "scenic city" or "gig city", "freight alley" or the "Silicon Valley of Trucking", it was the first city in the western hemisphere to boast gigabit speed broadband in 2009 (Lobo, 2020). The biggest employers in the city are Erlanger Health System, Blue Cross Blue Shield of Tennessee, Hamilton County Schools, Tennessee Valley Authority and the Unum Group.

The CRER's WP No. 9 shows that the healthcare practitioner and production worker groups are sharply larger in Chattanooga compared to the rest of the country. "*Nearly three quarters of the 27,430 workers in Transportation and Material Moving occupations were either manual movers, truck drivers, or stockers. The group is 16 percent larger locally than nationally. Chattanooga's most outsized occupation group is Production workers. Reflecting the area's large manufacturing sector, this group is 75 percent larger in Chattanooga than in the country as a whole.*"

2.3 Entrepreneurship

2.3.1 Business Investments

Data from the Chattanooga Area Chamber of Commerce on announced new business investments and expansions in the community show that over the period 2010 to 2025 approximately $6.3 billion of new businesses or expansions were announced in Chattanooga and the region. This non-exhaustive list is compiled from news media announcements and from direct contact with potential and existing firms.

There were 255 announced projects over the period 2011-2025. The total value of the announced investments was $6.31 billion. In the same period, the net new jobs were 12,790. Since 2020, 72 firms announced new investments or expansions totaling $2.73 billion and 6,477 jobs. During this period, around 2,000 jobs were lost to closures or layoffs.

Among the new firms reported to be investing in Chattanooga were *Sese Industrial Services* ($42 million; auto axles), *Red Stone Estates* ($17 million; senior living facility), *Embassy Suites, Holiday Inn* and *Marriott* ($119 million; hotels), and *Lantern at Morning Point* ($50 million; senior memory care center). Expansions were announced by *NOVONIX* ($1 billion; batteries), *McKee Foods* ($495 million; snack cakes and cookies), *GE Appliances* ($118 million; home appliances), *Gestamp Corp* ($95 million; auto supplier).

As indicated in Lobo (2020) and elsewhere, it is difficult to attribute business investments to the fiber infrastructure absent direct evidence from the relocating/expanding firms. However, evidence from corporate site selection surveys suggests that high-speed internet access and cost-efficient energy availability rank in the top 5 site-selection factors considered by firms. This would suggest that the fiber optic infrastructure has had a significant impact in attracting companies to the area.[4]

"The Gig" has benefited a wide range of occupations and industries since its launch in 2010. Startups and SaaS companies like *brev.dev*, *FreightWaves*, and *Branch Technology* rely on high-speed, low-latency internet for cloud computing, real-time collaboration, and continuous deployment. Remote developers and IT professionals benefit from symmetrical upload/download speeds for coding, testing, and deploying applications. Companies in logistics, warehousing, and advanced manufacturing use fiber to power Internet-of-things (IoT) devices, smart sensors, and real-time inventory systems. Clinics and hospitals use the fiber network for telehealth services, remote diagnostics, and real-time patient data sharing. Mental health professionals and therapists benefit from stable video connections for virtual sessions. Designers, video editors, and digital marketers benefit from fast upload speeds for large files, cloud rendering, and collaborative tools. Local media and content creators can stream, publish, and distribute content without bottlenecks. Additionally, the smart grid supports energy efficiency and uptime for industrial operations.

Firms continue to find Chattanooga and Hamilton County an attractive place to invest. The area continues to draw the interest of firms in the manufacturing, automobile, energy, logistics, food and beverage, and biotech industries according to the Chamber of Commerce.

2.3.2 Entrepreneurial ecosystem

Since the advent of the gigabit broadband service in Chattanooga in 2010, the city has attracted tech innovators and venture capital that has created a diverse startup scene with companies in product development, advanced manufacturing and sales management in industries such as digital media, healthcare, software development spaces, logistics and transportation (Lobo, 2020). Startups that have matured in the area include *FreightWaves*, *Branch Technology*, *Skuid*, *Bellhops*, and *WorkHound*. However, the "tech hub" moniker might be overstating reality in that bandwidth-hungry firms have not taken root in large numbers. The advanced fiber network and lightning-fast internet is a draw but is no longer unique fifteen years later. One city official said, "*it is foundational; necessary but not sufficient*." What remains attractive, however, is the innovativeness and collaborative spirit combined with top-notch fiber infrastructure, unmatched outdoor attractions, and logistical locational advantages.

Part of the Chattanooga ecosystem comprises the *CO.LAB* accelerator, which has been described as "*the front door for entrepreneurship in Chattanooga*," the *INCubator*, which houses the *Tennessee Small Business Development Center*, *The Enterprise Center* which leads development of Chattanooga's downtown *Innovation District*, a collection of business incubators and accelerators. The *Chattanooga Smart Community Collaborative* brings together the city of Chattanooga, Hamilton County, The University of Tennessee at Chattanooga, Erlanger Medical Center, Co.Lab and EPB under the direction of the Enterprise Center to address community issues

[4] Academic research shows that high-speed broadband positively impacts GDP and per capita income (Kongaut and Bohlin, 2017; Briglauer and Gugler, 2019). Others like Koutrompis (2018) additionally find evidence of nonlinear effects of higher broadband speed. Mack (2014) found that broadband speed is particularly important for firm presence in rural locations suggesting that broadband speed substitutes for the agglomerative benefits of urban locations.

with community resources.[5] The *River City Company* is focused on spurring economic development in downtown Chattanooga.

The fiber infrastructure has attracted tech startups to the area. Some more recent tech startups are listed in **Table 2.4**.

Table 2.4 Chattanooga's Top Tech Startups	
Humanaut	AdTech; 35 employees
Signix	Blockchain, Software; 35 employees
Ambition	Analytics; 104 employees
Conversant Group	AI, Consulting; 98 employees
Branch Technology	3D Printing; 39 employees
Workhound	Software; 28 employees
Notes: Source: builtin. These are companies headquartered in Chattanooga.	

Several venture capital firms and angel investor groups are located in Chattanooga, TN, playing a significant role in fostering the city's growing entrepreneurial ecosystem. Some of them from *Angel Match* are listed below:[6]

- ***Dynamo Ventures***: Specializes in investing in enterprise, pre-seed, and seed-stage businesses globally, with a focus on logistics technology.
- ***River Associates Investments***: A private equity firm that also provides funding to startups, typically targeting U.S. and Canadian companies.
- ***Tenth Street Capital***: A venture capital firm providing capital to the lower middle market by providing mezzanine debt and equity co-investments.
- ***Chattanooga Renaissance Fund***: A formalized angel capital fund that encourages entrepreneurship and economic growth in Tennessee and the surrounding regions, investing in seed and early-stage companies.
- ***Capacity Capital***: Focuses on early-stage, high-growth, cash-efficient ventures in the Southeast, primarily investing in tech-related startups.
- ***The JumpFund***: A venture capital firm that focuses on funding women-led companies.
- ***Lookout Capital***: Offers factoring and accounts receivable financing to carriers, brokers and transportation professionals.
- ***Solas BioVentures***: Specializes in investing in the Life Science industry, with a focus on early and development stage Biotech, Medtech, and Digital Health companies.
- ***FourBridges Capital Advisors***: An investment banking firm for the middle market.
- ***Chestnut Funds***: A venture capital fund focused on acquisition and development of commercial real estate.
- ***Lamp Post Group***: A venture incubator.

[5] See Morrison and Bevilacqua (2018) for more on the evolution of Chattanooga and the efforts of public and private actors to limit the negative externalities of the ecosystem via socio-economic, urban and housing strategies.
[6] It is important to note that while some sources list broader regional or global venture capital firms in Chattanooga, those listed above have a more direct presence or focus on the Chattanooga area. Angel investors, while not necessarily venture capital funds, are also crucial in the early-stage funding landscape in Chattanooga.

Chen (2025) notes that Chattanooga is on the verge of a significant economic transformation, driven by a combination of local entrepreneurship, strategic investments, and favorable market conditions. She cites the Brickyard incubator-backed Brev.dev's recent [2024] acquisition by Nvidia as testament to the city's growing reputation as a tech hub. Cam Doody, a key player in Brickyard, envisions a future where the city could host around 150 high-growth firms, collectively raising billions in venture capital. This vision aligns with the broader trend of businesses seeking locations that offer not just economic advantages but also quality of life.

2.3.3 Microbusiness Density and Activity

Digital microbusiness density provides an ongoing measure of startup vitality and entrepreneurship that drives job creation, boosts household income growth, and reduces unemployment. A microbusiness is defined by domain name provider GoDaddy as those having 10 or fewer employees, a domain, and an active website. Research by GoDaddy Venture Forward shows that every additional microbusiness entrepreneur adds about seven jobs at the county-level.

A measure of microbusiness density**,** a metric based on the number of active domain names per 100 people, was created by economists at the UCLA Anderson Forecast in partnership with GoDaddy Venture Forward. This data begins in 2019 and the record for Chattanooga relative to the rest of the country is shown in **Figure 2.3.**

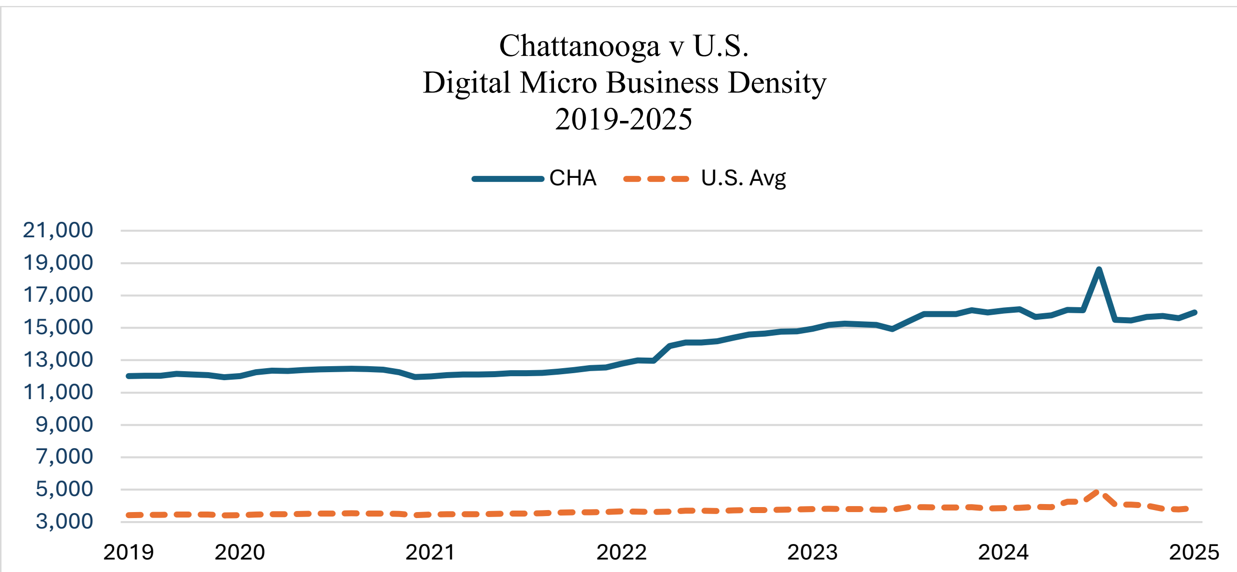


Fig. 2.3 Chattanooga Digital Business Density

It is clear that the level of digital business density is sharply higher in Chattanooga than most other places in the U.S. Such activity is crucially dependent on the fiber infrastructure that provides high-speed and high-quality broadband access to the internet.

2.4 Broadband Profile

Table 2.5 Hamilton County: Internet Service Type Adoption			
	Hamilton County	Tennessee	USA
Broadband (cable, fiber optic, DSL)	80.5%	71.1%	74.6%
Cellular Data Plan	85.8%	80.3%	83.2%
Cellular Data Plan Only	8.6%	12.4%	11.3%
Satellite Internet Service	2.4%	6.2%	6.6%
Dial-up with no other type of internet subscription	0.0%	0.1%	0.2%
Without an internet subscription	9.6%	12.4%	10.1%
Source: Census ACS 5-Year, 2023			

Broadband and cellular data are the lead internet service types across the U.S., Tennessee and Hamilton County.[7] Since 2017, the percentage of households with a broadband subscription in Hamilton County has risen 14.2 percent, with the county holding higher adoption rates than both the U.S. and state of Tennessee in 2023. The percentage of households in the county that have no internet service has declined from 24.5 percent in 2017 to 9.6 percent in 2023. The county has fewer households without internet service when compared to the state at 12.4 percent.

Broadband adoption has improved across all income classes in Hamilton County. Approximately 96.9 percent of households with annual incomes of $75,000 or more have a broadband internet subscription. For households with incomes between $20,000 and $75,000, 85.1 percent reported having a broadband subscription in 2022. The lowest income class, those making less than $20,000, have seen improvements in broadband adoption. In 2017 just 45.4 percent reported having a broadband subscription. By 2022, that percentage increased to 68.7 percent. While the improvement across the lowest income households is dramatic, there are several possible reasons for the improvement. A combination of factors, from EPB maintaining a set fiber optic internet price, to government programs like the Affordable Connectivity Program, and the local ***EdConnect*** partnership between EPB, Hamilton County Schools (HCS) and community partners that provides free fiber optic service to households with students on free or reduced lunch programs, are possible reasons for the increase in adoption among lower income households.

By June 2024, roughly 70 percent of the Chattanooga residential market and 41 percent of the commercial market subscribed to EPB fiber optic broadband services as seen in **Fig 2.4**.[8] As of April 2025, over 122,000 residential households in the EPB footprint were fiber customers.

[7] Broadband is defined by the Census to include cable, fiber optics, and DSL

[8] Take rates were determined based on the residential and commercial accounts that subscribe to EPB electric service. As the only distributor of electric service in EPBs service territory, electric subscriber counts offer a more accurate measure when determining fiber optic take rates. Data includes both data-only and bundled fiber plans.

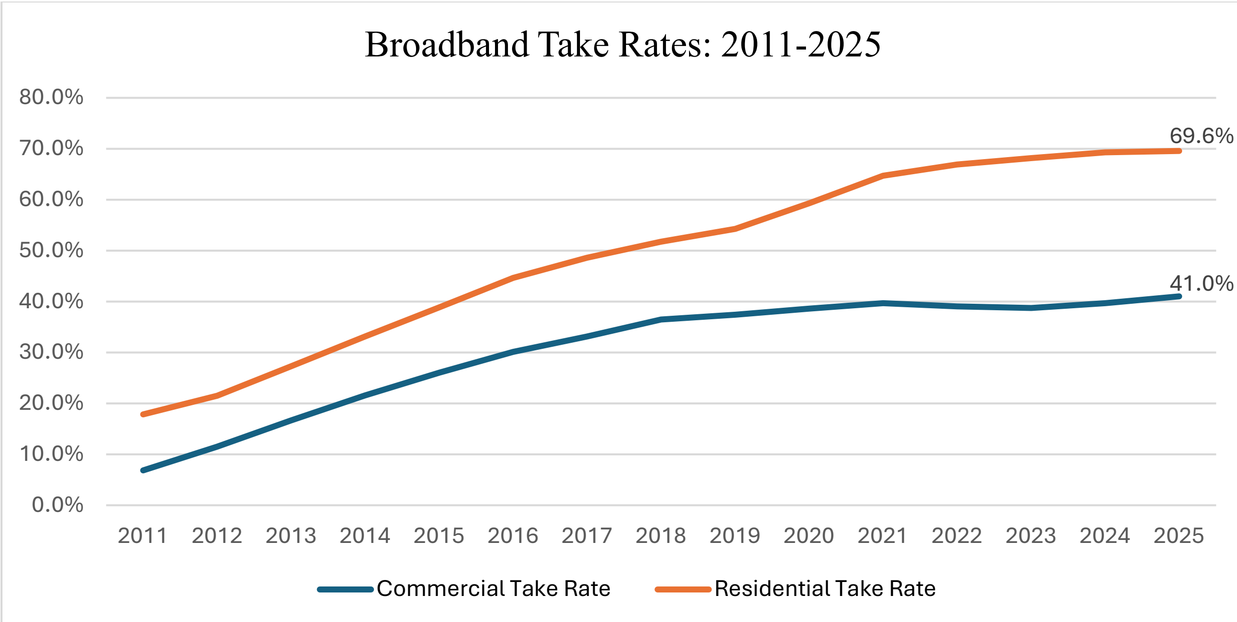


Fig. 2.4 Residential and Commercial Fiber Broadband Take Rates

Since the pandemic, the residential take rate has increased with the growth being driven by gig and multi-gig service. **Fig 2.5** shows that the gig take rate in particular has steadily increased while the growth in the "slower" 300 Mbps has slowed reflecting the value of greater bandwidth. For $10 more per month, customers consider this an attractive offer.[9] As of June 2025, the 300 Mbps take rate was about 38 percent, while the take rate for the gig had grown to roughly 30 percent marking a potential future shift in the most adopted speed tier. EPB's 2.5 gig and 10 gig services are also growing, representing a take rate of just over 1 percent.

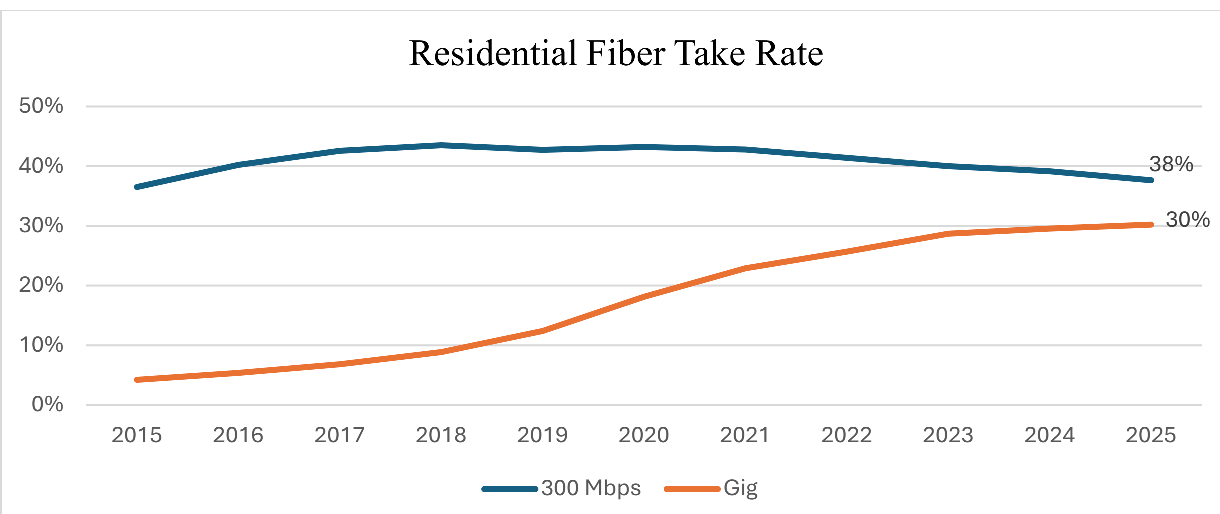


Fig. 2.5 Residential Fiber Broadband Take Rate

[9] Since 2019, EPB's 300 Mbps service costs $57.99/month, while the gig service costs $67.99/month. These services have no data caps or installation charges.

CHAPTER 3. THE COMMUNITY BENEFIT

3.1 Estimates

3.1.1 Previous Estimates: 2011-2020

In a ten-year lookback at the value of fiber optic infrastructure in Hamilton County, TN, Lobo (2020) provided analytically computed estimates of the value of the fiber optic infrastructure. These estimates were broadly placed in four categories: Household, Business, Utility and Community. He reported that the "…economic value of …high-speed broadband and the smart grid, minimally exceeds $2.69 billion and 9,516 jobs….".

As seen in **Fig 3.1**, the value of the infrastructure stemmed from:

- Smart Grid benefits
- Economic development
- Productivity gains
- Consumer surplus
- Specific areas of community effects e.g. healthcare, telecommuting, education

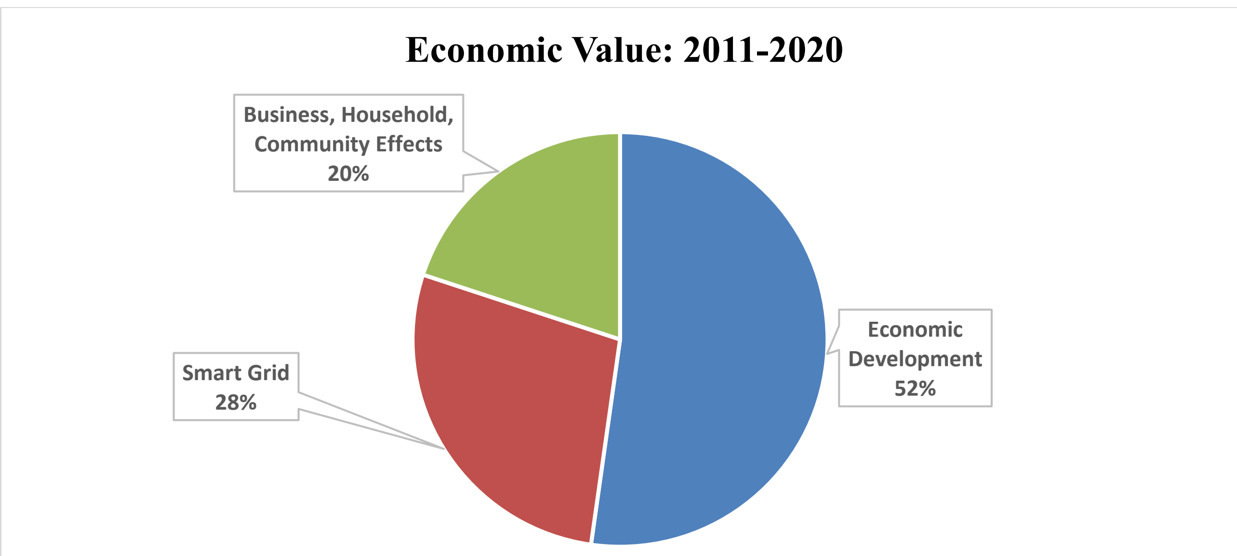


Fig. 3.1 The Economic Value of Fiber Optic Infrastructure 2011-2020

3.1.2 Current Estimates: 2011-2025

EPB is organized in two divisions: Electric and Fiber Optic. The latter refers to the legacy telecom, and video and internet lines of business. The two major lines of business that stem from the fiber optic infrastructure are the smart electric grid and community-wide high-speed broadband.

Current estimates of realized value are a hybrid of model-based and analytical estimates that look back fifteen years over the period 2011-2025. We use an input-output model to measure the contribution of high-speed broadband to the community. We use analytical methods to measure other effects of the fiber infrastructure such as smart grid savings, residential bill savings, consumer surplus and media exposure. **Table 3.1** contains a summary of our estimates.

Table 3.1 Summary of Fiber Infrastructure Benefits 2011-2025	
High-speed broadband contribution	$3,727,709,861
Smart grid savings	$1,093,997,349
Residential bill savings	$332,163,735
Consumer surplus due to high-speed broadband	$98,123,860
Media coverage of fiber infrastructure	$82,146,906
Total Value to the Community	$5,336,415,040
Total Jobs	**10,420**

We find that over the period 2011-2025, the fiber optic infrastructure has created over **$5.3 billion** in value for the community, in addition to over **10,400 jobs**. About 70 percent of this value can be attributed to high-speed broadband and about 30 percent to the smart grid and other effects.

3.2 High Speed Broadband Effects

To estimate the incremental economic contributions of the fiber optic infrastructure to Hamilton County, we applied an Industry Contribution Analysis (ICA) method in IMPLAN. Unlike an economic impact analysis, a contribution analysis is designed to examine how an existing investment/industry supports or contributes to the economy in the defined region (See **Appendix 3** for more details).

An annual industry contribution model was developed for Hamilton County, Tennessee, based on the Fiber division's total revenues, i.e. revenues that would not be available if the fiber division did not exist.

Fig. 3.2 shows the contribution of the fiber division to EPB over the years. The sharp uptrend in EPB's net revenues post 2010 is driven by a) new net fiber revenues and b) a decline/slowdown in electric expenses presumably due to the smart grid.

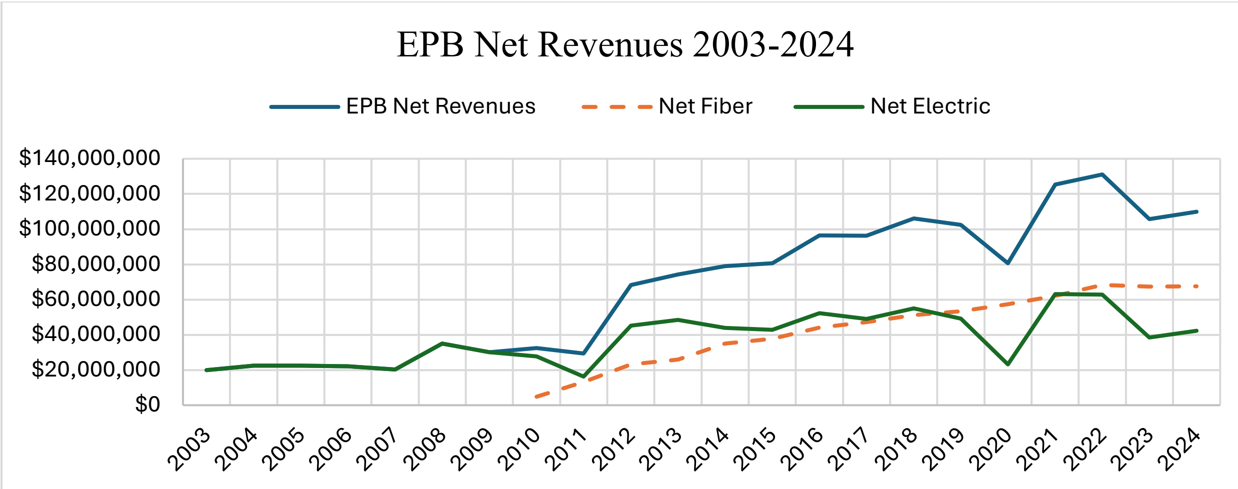


Fig. 3.2 EPB Net Revenues 2003-2024

In a comprehensive study of every municipally owned and operated fiber-to-the-home (FTTH) network in the U.S. operating in the period 2010 through 2019, Yoo et al (2022) found that EPB's network was the only project to satisfy (both adjusted net cash flow and NPV of cash flow from operations) criteria for long-run viability.[10]

In **Fig. 3.3**, we see the growth in cash flows from operations and net profit from the Fiber division. The division has consistently generated cash and except for 2011, a healthy net profit. The CAGR for cash flow from operations (CFO) has been 8.7 percent from 2011 to 2024.

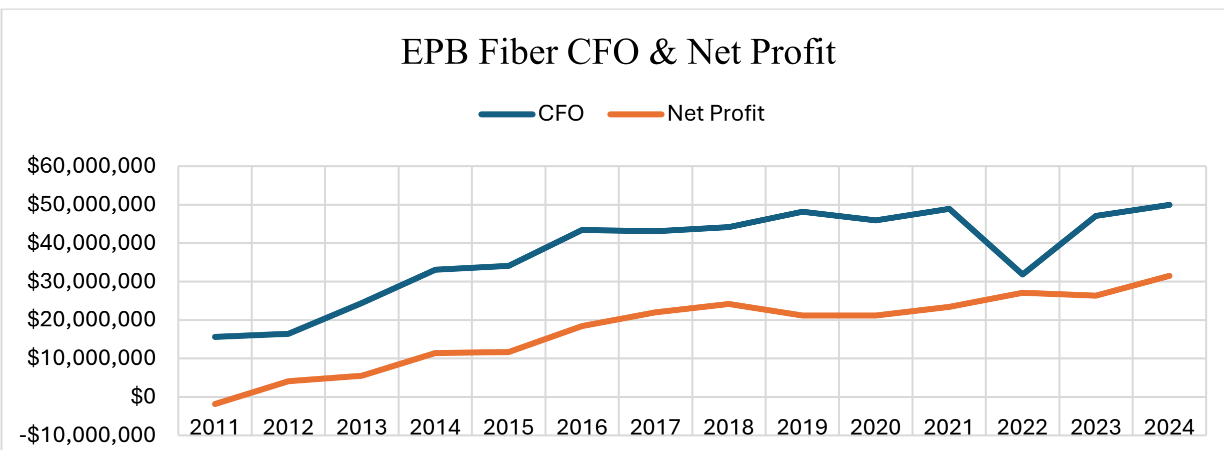


Fig. 3.3 EPB Fiber Division Cash Flow from Operations and Net Profits

IMPLAN Contribution Analysis: Output Effects

We attribute the annual revenues generated by the fiber division to the "*Wired Telecommunications Carriers*" sector of IMPLAN for each study year (2011-2025). The results for high-speed broadband contributions to the community are summarized in **Table 3.2**. As explained in

[10] They reached this conclusion after assuming the $111.6 million stimulus grant in 2009 had been replaced with bond debt and all of the bond debt associated with the fiber network was carried by the Fiber Optics System.

Appendix 3, direct contributions result in multiplier effects reflected in indirect and induced effects. The total output effects are the sum of direct, indirect and induced effects in the community.

Table 3.2 High-Speed Broadband Output Effects (2011-2025)			
	2011-2020	**2011-2025**	*Change from 2020 to 2025*
Direct Effect	$1,273,350,669	$2,232,596,993	$959,246,324
Indirect Effect	$536,077,483	$1,100,030,049	$563,952,566
Induced Effect	$233,028,171	$395,082,819	$162,054,648
Total Effect	$2,042,456,323	$3,727,709,862	$1,685,253,538
Output Multiplier	1.60	1.67	

The estimates indicate that high-speed broadband has contributed as much as **$3.73 billion** to the community over the period 2011-2025. Since 2020, total output has increased at a faster pace as seen in the higher output multiplier. The output multiplier of 1.67 means that every dollar of fiber division revenue generated an additional 67 cents of economic activity elsewhere in the local economy. For perspective, the high-speed fiber broadband contributed approximately one percent of annual Hamilton County GDP on average.

These output effects reflect business investments (new, expansions and contractions), business efficiencies, as well as payments in lieu of taxes to local governments (PILOT), and telecommuting, telehealth, education and other community benefits identified in Chapter 7 of Lobo (2020). A listing of the top industries impacted by indirect or induced effects is contained in **Table 3.3** below.

Table 3.3 Broadband Impact by Industry: Indirect and Induced Effects			
Industry (top 10)	**Indirect Effect ($Mil)**	**Industry (top 10)**	**Induced Effect ($Mil)**
429 - Motion picture and video industries	$281.87	449 - Owner-occupied dwellings	$51.18
472 - Employment services	$100.59	490 - Hospitals	$20.06
432 - Cable and other subscription programming	$94.25	483 - Offices of physicians	$17.57
447 - Other real estate	$73.45	447 - Other real estate	$17.27
499 - Independent artists, writers, and performers	$68.81	444 - Insurance carriers, except direct life	$14.17
431 - Radio and television broadcasting	$52.74	510 - Limited-service restaurants	$13.50
465 - Advertising, public relations, and related services	$27.43	509 - Full-service restaurants	$11.74
527 - Federal electric utilities	$18.23	448 - Tenant-occupied housing	$11.34
434 - Wireless telecommunications carriers (except satellite)	$17.34	441 - Monetary authorities and depository credit intermediation	$8.88
455 - Legal services	$17.17	413 - Retail - Nonstore retailers	$7.75

All Other Industries	$382.66	All Other Industries	$309.19
Source: EPB, IMPLAN® model for Hamilton County, TN, 2011-2024			

We see further evidence of the value of fiber in business development in the Microbusiness Activity Index (MAI), developed by economists at UCLA and GoDaddy Venture Forward. The measure tracks dozens of factors that impact the success of online microbusinesses – all captured in one composite score. The score is also decomposed into three subindices: infrastructure, participation, and engagement. **Fig. 3.4** below shows that Hamilton County, TN, has had higher digital microbusiness activity per capita when compared to the U.S. average. This outperformance is mostly due to the "Infrastructure" portion measuring the "*physical infrastructure necessary to access and use the internet*." This metric largely captures local fiber availability. Additional evidence comes from Biedny, et al., (2024) who found in a study of eight states that were introduced to faster speed broadband (100+ Mbps) between 2015 and 2020 that the availability of higher speeds (250 Mbps or 1 Gbps) encouraged more new business births compared to otherwise-similar areas that only got 100 Mbps service.

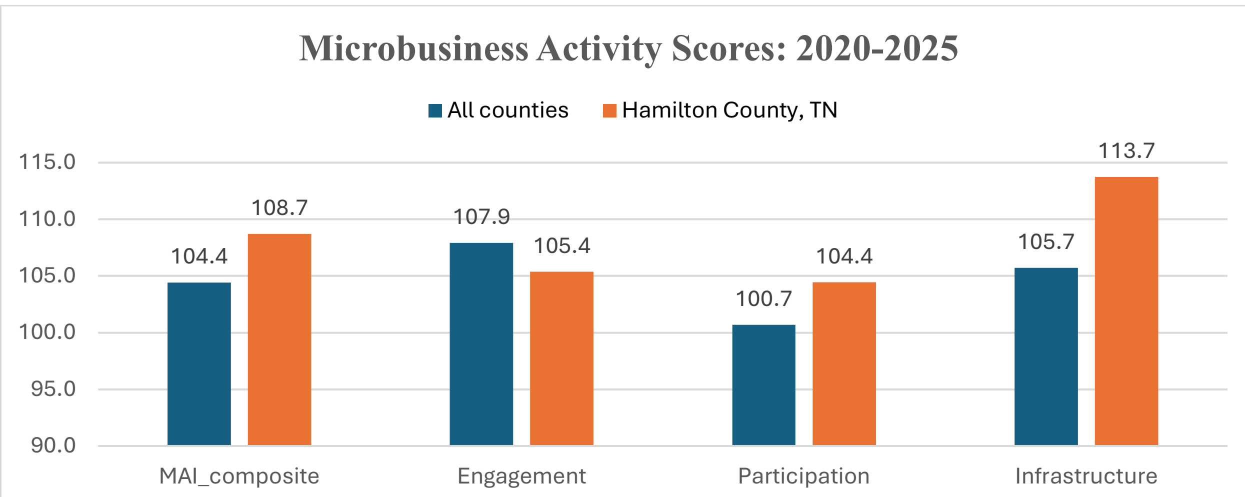


Fig. 3.4 Chattanooga Microbusiness Activity

3.3 Employment Effects

To estimate the incremental jobs attributable to high-speed broadband in Hamilton County, we rely on the empirical model provided in the *Telecommunications Policy* journal article by Lobo, Whitacre and Alam (2020). In that paper, the authors examine the effects of broadband speed on county unemployment rates in Tennessee. They employ panel regressions that control for potential selection bias, reverse causality and a host of factors that could influence the relationship between broadband speed and unemployment rates. They find that high-speed broadband reduces unemployment rates by 0.26 percentage points, thereby saving or creating new jobs in a county. They also document that the average benefit to early adoption of high-speed broadband is 0.16 percentage points.

For the period 2011-2025, we estimate jobs attributable to high-speed broadband as follows:

Jobs attributable to high-speed broadband each year = Hamilton County working age population X *(high-speed broadband effect + early adoption effect)*

Note that for the period 2020-2025, we do not apply the early adoption effect on assumption that the "gigabit honeymoon" period lapses with the passage of time as technology usage matures.

Using the latest BLS population data, we estimate the number of jobs saved or newly created due to high-speed broadband infrastructure in Hamilton County is 12,523, up 3,007 since 2020. [11] Since 2020, more ISPs have begun to offer fiber services in Chattanooga. The details on start dates and product offerings for these ISPs are not clear. However, to accommodate this development, we adjust the employment estimate for EPB's fiber impact on area employment by scaling the new jobs estimate by the change in EPB's market share since 2020 (i.e. +12%). This adjustment allows us to be consistent with previous estimates in Lobo (2020). The estimate of total number of jobs saved or newly created is **10,420,** comprising 9,516 jobs reported in Lobo (2020) and 361 new jobs since 2020.

The occupations most impacted by the fiber infrastructure are listed in **Table 3.4.**

Table 3.4 Broadband Impact by Occupation

Top 10 Occupations	Wage and Salary Employment
Computer Occupations	802.97
Electrical and Electronic Equipment Mechanics, Installers, and Repairers	794.21
Information and Record Clerks	598.35
Other Installation, Maintenance, and Repair Occupations	556.23
Business Operations Specialists	540.75
Material Moving Workers	479.35
Sales Representatives, Services	461.95
Food and Beverage Serving Workers	354.26
Retail Sales Workers	327.5
Entertainers and Performers, Sports and Related Workers	314.22

Our estimates are consistent with Wagner and Lee (2024) who find robust evidence that faster business download speeds are causally linked to higher employment growth among all establishments, establishments with 5 or fewer workers, and among start-up firms. Moreover, they find that expanded broadband infrastructure increases both the birth rate of new establishments and their 5- and 10-year survival rates.

3.4 Smart Grid Savings

The fiber infrastructure has enabled the smart grid to generate significant savings and efficiencies in EPB's electric division. These are detailed in **Chapter 4**. Briefly, the savings stem from operational efficiencies, peak demand reduction, outage minutes and costs saved during major storm and non-storm events, reduced pollution benefits and reduced power theft. Over the period

[11] We attribute these jobs to the fiber infrastructure because the estimates in Lobo *et al*. (2020) are based on *symmetrical* high-speed service which only fiber broadband can currently provide.

2014-2025, we estimate these savings have generated in excess of $1.09 billion in total value to the region, enabling the utility to build a financial reserve for future contingencies without the need to raise electric rates or borrow from capital markets.

3.5 Payments-in-Lieu-of-Taxes

The fiber optic division of EPB, comprising video & internet and telecom services, has contributed to the city and county in the form of payments-in-lieu-of-taxes (PILOT). Additionally, a portion of the EPB electric division's PILOT is also attributable to the fiber infrastructure (Lobo, 2020). The total amount of payments in lieu of taxes contributed by the fiber optics division over the period from 2011 to 2024 was $84.06 million, as seen in **Table 3.5**. These PILOT effects are captured in the contribution analysis reported in Table 3.2.

Table 3.5 EPB Payments-In-Lieu-of-Taxes due to Fiber Optic Infrastructure

	Fiber Optics		**Electric***	**Total**
($000's)	Video & Internet	Telecom		
FY 2011	$465	$947	$2,612	$4,024
FY 2012	$641	$906	$3,838	$5,385
FY 2013	$759	$817	$4,075	$5,651
FY 2014	$803	$742	$4,153	$5,698
FY 2015	$915	$679	$4,389	$5,983
FY 2016	$929	$665	$4,518	$6,112
FY 2017	$977	$679	$4,799	$6,455
FY 2018	$1,088	$730	$5,033	$6,851
FY 2019	$1,158	$763	$5,118	$7,039
FY 2020	$1,100	$771	$4,767	$6,725
FY 2021	$1,127	$780	$4,799	$6,706
FY 2022	$1,046	$765	$4,611	$6,422
FY 2023	$976	$742	$4,594	$6,312
FY 2024	$709	$686	$3,302	$4,697
Total	$12,693	$10,672	$60,608	$84,060

Source: EPB Annual Reports. * A portion of the EPB electric division's PILOT attributable to the fiber infrastructure; estimates provided by EPB.

3.6 Consumer Surplus

In assessing the value of high-speed fiber broadband, we consider work done in measuring the economic impact of the internet because high-speed broadband helps access the internet. The measurement is complex because so much of the impact of the internet has no price, i.e. non-monetary benefits. Brynjolfsson et al. (2018) argue that GDP and derived metrics such as productivity are inadequate when considering digital goods and goods with no observable market prices. Changes in consumer surplus, on the other hand, provide a superior and more direct measure of changes in well-being in such cases.

Consumer surplus refers to the difference between what a consumer is willing to pay (WTP) and what they actually pay for a good or service. We use it as a proxy for the additional non-monetary benefits of high-speed, high-quality internet access, i.e. hard-to-measure benefits such as shopping, entertainment, work and job searches, news, health care, personal finances, social networking, travel, education and interactions with governments.

Recent research shows that consumer surplus for high-speed and quality broadband is significant. Rabbani et al (2024) find that users are willing to pay an extra $1.13 per month for a 1 megabits per second (Mbps) faster internet and $45.52 per month for better connection quality. Boyce (2024) estimated households are willing to pay between $45–334 per month to go from not being connected to having speeds of 25 - 1,000 Mbps and are willing to pay $10 - $38 per month for fewer outages, depending on household income levels.

To calculate the consumer surplus of the fiber-delivered symmetrical high-speed broadband in Hamilton County, we use the findings in Boyce (2024) as reported in **Table 3.6**. On average, a typical local household experiences a consumer surplus of $68.85 per month at the 300 Mbps service level. Similarly, the consumer surplus is $58.85 per month at the Gig speed level. In total, we estimate consumer surplus of **$98,123,860** for Hamilton County, TN.

Table 3.6 Consumer Surplus

300 Mbps			1,000 Mbps		
WTP	Price	# Households§	WTP	Price	# Households§
$112.90 + $13.94	$57.99	66,892	$123.08 + $13.94	$67.99	51,738
Annual Consumer Surplus = $55,266,170			Annual Consumer Surplus = $42,857,690		

Note: Annual CS = (WTP – Price) * # Households *12. WTP based on median income household; Customers were willing to pay $13.94 for greater reliability, i.e. fewer outages [Boyce, 2024 Table 5]. § Customer count as of Oct 2024.

3.7 Residential Bill Savings

The fiber optics division at EPB has helped reduce operating and maintenance (O&M) costs while also generating access fee revenues for the electric division. In **Table 3.7**, we see that the O&M cost savings amounted to $292.5 million over the period 2011-2025, while access fees and rents paid by the fiber optics division contributed $240.9 million to the electric division. The fiber optics division has been profitable since 2012. These divisional profits amounted to $282 million for the period from 2011-2025.

Table 3.7 Electric System Cost Savings Due to Fiber Optics Division

	Fiber Optics O&M Allocation ($000)	Fiber Optics Access Fees & Rent Paid ($000)	Fiber Optics Net Profit ($000)
2011	$5,367	$5,374	-$1,835
2012	$7,118	$8,629	$4,086
2013	$8,810	$9,210	$5,550
2014	$9,658	$11,430	$11,401
2015	$13,014	$13,982	$11,676
2016	$14,904	$14,384	$18,425
2017	$19,399	$15,302	$22,019
2018	$22,584	$15,631	$24,192
2019	$25,403	$19,118	$21,202
2020	$26,563	$17,760	$21,173

2021	$28,990	$18,960	$23,404
2022	$28,951	$22,354	$27,128
2023	$25,286	$23,207	$26,307
2024	$28,232	$21,562	$31,502
2025#	$28,266	$23,993	$35,774
Total	$292,548	$240,896	$282,004
Source: EPB. # Estimate.			

The cost savings and cash generated by the fiber optics division (over $815 million in fifteen years) has resulted in lower internet and power bills for residents, the build-up of cash reserves to deal with contingencies and plant replacement and maintenance, deferment of electric rate hikes, and avoided costly capital market transactions (e.g. bond issues). Fitch, a leading national credit rating agency, reaffirmed its AA+ rating of EPB in May 2025. The agency said, "*The 'AA+' rating and stable outlook for Chattanooga Electric Power Board (EPB) reflect its very low leverage ratio, strong revenue defensibility, and robust financial performance, with leverage expected to remain between 6.5x and 6.7x over the next five years despite projected additional debt issuance*."

In **Table 3.8**, we show the size of community savings on electric bills due to the fiber optic division. We calculate how much higher the revenues of the electric division would need to have been to maintain the same level of net income reported, absent access fee revenues and cost savings generated by the fiber optic division. To make this calculation, we take the ratio of fiber optic access fees and O&M allocations to the electric division revenues and find that, on average, electric rates would have had to rise *6.28 percent each year*, roughly $8.94 per month or $107.32 per household per year, for EPB to generate the same level of net income without the cost savings and revenues provided by the fiber optics division. Based on average monthly residential electric bills in Hamilton County, we calculate this benefit to the community to be **$266.9 million** in residential cost savings, roughly $1,640 per household, over the period 2011-2025.

Table 3.8 Community Cost Savings Due to Fiber Optics Division

	Fiber Transfers to Electric ($000)	Annual Electric Revenues ($000)	Fiber Transfers as % of Electric Revenues	Average Monthly Residential Electric Bill [12]	Number of Residential Meters	Annual Community Savings
2011	$10,741	$535,582	2.01%	$130.00	149,062	$4,663,482
2012	$15,747	$544,177	2.89%	$130.72	147,385	$6,690,284
2013	$18,020	$535,968	3.36%	$131.78	148,384	$7,889,251
2014	$21,088	$545,852	3.86%	$131.69	150,033	$9,159,895
2015	$26,996	$543,843	4.96%	$136.14	153,982	$12,487,279
2016	$29,288	$539,908	5.42%	$140.06	155,712	$14,196,659
2017	$34,701	$557,040	6.23%	$141.79	157,173	$16,659,306
2018	$38,215	$557,293	6.86%	$142.87	158,516	$18,635,818
2019	$44,521	$560,050	7.95%	$141.14	160,881	$21,660,886
2020	$44,323	$531,285	8.34%	$138.36	162,048	$22,445,912

[12] Estimated by taking the customer charge plus the average usage times the average rate. It does not consider how usage and prices might fluctuate across the year, and it also does not include any miscellaneous charges (late fees, disconnect fees, etc.).

2021	$47,950	$532,950	9.00%	$143.18	163,996	$25,351,421
2022	$51,305	$580,606	8.84%	$155.80	165,729	$27,379,556
2023	$48,493	$609,294	7.96%	$153.78	168,628	$24,766,559
2024	$49,794	$613,301	8.12%	$158.21	172,251	$26,551,061
2025	$52,259	$622,549	8.39%	$160.67	175,231	$28,360,770
Total	$533,444		6.28%#			$266,898,140
Source: EPB and author calculations. Fiber transfers to the Electric division are access fees/rents and O&M allocations. # average. Data for 2025 are estimated.						

Competition and Free Service Upgrade

Not only has the community benefited from lower electric bills, it has also benefited from competition in the broadband space as other providers have elected to drop their prices and increase their service offerings (improve quality). **Fig 3.5** shows prices per megabit for the highest bandwidth product offered in the Chattanooga/Hamilton County area by various providers.

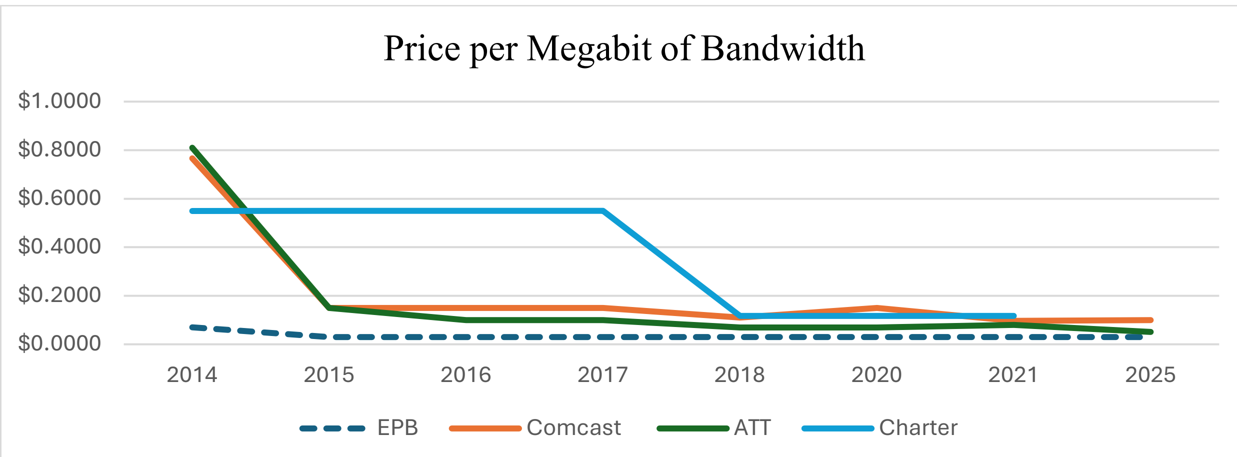


Fig. 3.5 Price per Megabit of Bandwidth

It is clear that prices have declined sharply since 2014 (in line with the rest of the country), but prices for Comcast (Xfinity), AT&T and Charter remain higher than EPB's price point. At the time of writing, EPB is the only provider with no data caps or installation fees attached to their service.

Fig. 3.6 shows the highest bandwidth product offered from 2014 to 2025 by various providers. In 2014, EPB offered 1000 Mbps, while Comcast, ATT and Charter offered 150, 100 and 10 Mbps, respectively. By 2021, EPB's highest bandwidth product was 10 Gig (10,000 Mbps), where Comcast, ATT and Charter offered 1200, 1000, and 940 Mbps, respectively. As of May 2025, the highest bandwidth products that Comcast and AT&T offer are a 1.3 Gig and 5 Gig, respectively.

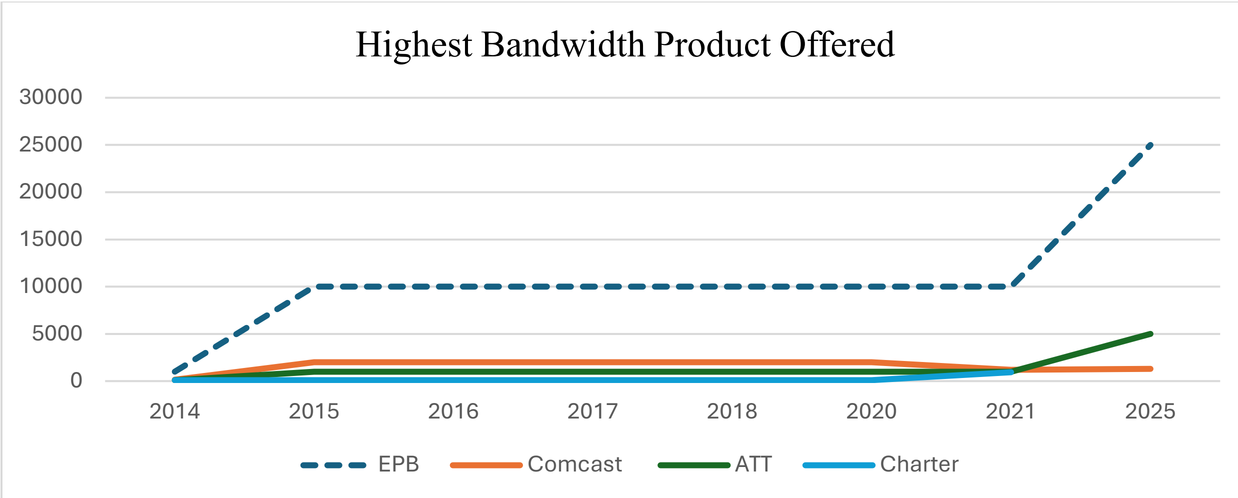


Fig. 3.6 Highest Local Bandwidth

In February 2019, EPB increased the bandwidth of base tier fiber customers at no additional charge from 100 Mbps to 300 Mbps to meet the demands of increased home connectivity. With EPB holding the price of the service at $57.99, customers experienced a decrease in the cost of service from $0.58 to $0.19 per Mbps, a savings of $0.39 per Mbps. Base tier fiber residences experienced a benefit of $78 per month. Additionally, the utility decreased the price of gig speed internet from $69.99 per month to $67.99 per month, resulting in savings of $2 per month per gig subscriber. Gig customers are estimated to have experienced a benefit of $24 annually at the new service price. Calibrating these benefits to customers that had service in February 2019, we calculate that fiber customers benefited by over $5.4 million a month, with the annual benefit of a free service upgrade amounting to $65,265,595.

In total, we estimate total residential bill savings in the EPB territory to be the sum of electric bill savings and the value of free service upgrades amounting to **$332,163,735** over the period 2011-2025.

3.8 Media Coverage

Lobo (2015) notes that since 2010, the fiber optic infrastructure, the "Gig City", and the smart grid have been garnering global awareness and media coverage. This coverage has given the area national and global visibility and attracted firms and talent. A sampling of media sources and articles through 2019 is listed below:

The Guardian – How One City's Super-Fast Internet is Driving a Tech Boom
New York Times – Fast Internet is Chattanooga's New Locomotive
CBS Morning News – Which City has the Fastest Internet in the Nation?
Al Jazeera English – New Technology to Protect U.S. Grid
CNBC – Rebooting Chattanooga's Fortunes
Atlanta Journal Constitution – Technology Thriving
Wired – Where High Speed Internet Meets Smart Grid
Fast Company – A Small City with a Smarter Grid
GreenTech Media – Top 10 Utility Smart Grid Deployments in North America
The Economist – The need for speed

Wall Street Journal – Cities start own efforts to speed up Broadband
Wall Street Journal – Getting "Smart" on Outages
Forbes – The New Metropolis: The New Urban Pioneers
CNN Money – This city is giving super-fast internet to poor students
Forbes – Today's Must-Reads For Business Owners: The Secret To Chattanooga's Tech Surge
CNET – How blazing internet speeds helped Chattanooga shed its smokestack past
Washington Post – Most Americans want to let cities build and sell homegrown Internet service
CNBC.com – Forget Silicon Valley, these 7 cities are great for start-ups
The Verge – Tennessee city that fought Comcast and won announces 10Gbps internet
Yahoo! News – New Netflix list ranks the fastest ISPs in the United States
The Daily Beast – Chattanooga Has Its Own Broadband—Why Doesn't Every City?
INC.com – These 5 Traits Make for The Perfect Startup City
The New Yorker – Why the F.C.C.'s Municipal-Broadband Ruling Matters, Too
Consumer Reports – Are City-Owned Municipal Broadband Networks Better?
Fortune – One of America's Most Startup-Friendly Cities Is in Tennessee
PBS Newshour – Small towns join forces to bridge the digital divide
PCMag.com – How Chattanooga became a tech hub

A further sampling of media coverage of the fiber optic infrastructure since 2019 is listed below:

The New York Times - How A.I. Could Reshape the Economic Geography of America
CNET – Say Hello to the Country's Fastest Residential Internet Plan – in Chattanooga, Tennessee
Bloomberg – Chattanooga to Open First Commercial Quantum Network in July
AP News – EPB Quantum Network powered by Qubitekk hosts Oak Ridge National Laboratory's first run on a commercial quantum network
MarketWatch – The next Austin? This booming city in Tennessee is about to take a leap into quantum networking.
American Thinker - Chattanooga Goes Brave New World - American Thinker

This high-quality exposure helps draw the attention of vibrant and innovative workers and entrepreneurial talent to the area. It also draws business investment to the area. We estimate that over the period 2010-2024, the features of the fiber optic infrastructure, high-speed broadband and the smart grid, and more recently, the quantum initiative, have brought media attention to Chattanooga and Hamilton County in the form of about 3,400 print articles, blogs, or radio spots as seen in **Table 3.9.**[13] This media coverage is estimated to have reached over 7.8 billion unique viewers/readers/listeners resulting in about **$82.1 million** in advertising-equivalency value to the community, i.e. approximately over $5 million a year.

[13] EPB uses the Meltwater news clipping service along with their own scans of the news to identify the media coverage.

Table 3.9 Broadband, Smart Grid and Quantum Media Coverage			
	Total number of stories	Circulation: Unique Visitors	Advertising Equivalency Value[14]
Jan 2010 – Apr 2015*	1,885	3,009,395,237	$24,374,101
Aug 2015 – Feb 2020*	353	1,061,798,749	$23,118,813
Mar 2020 – Dec 2024§	1,157	3,746,377,352	$34,653,992
Total	3,395	7,817,571,518	$82,146,906
Source: * Lobo (2020); § EPB.			

3.9 Positioning for the future

Hamilton County, anchored by Chattanooga, is emerging as a national leader in quantum networking. "*With the deployment of the first commercial quantum network in the U.S. by EPB and strategic partnerships with companies like IonQ, the region is projected to generate…*[large]*…economic gains over the next decade through job creation, tech startups, and infrastructure development*" (Flessner, 2024). The region is positioned to support national security goals and commercial applications in energy, AI, and telecommunications. More discussion is contained in Chapter 6.

The 2025 Heartland Summit, think-and-do tank Heartland Forward honored Chattanooga (and two other cities) as a *Secret Sauce Community,* highlighting the city's innovative approach to economic growth, community development and cultural vitality, for having the right ingredients to thrive.

The citation noted that *"Chattanooga continues leveraging its first-of-its-kind publicly owned gig internet network to drive tech innovation and entrepreneurial growth, now becoming a hub for quantum and AI.*"

Chattanooga Mayor Tim Kelly said, "*Chattanooga is proof that a mid-sized city can punch above its weight when we focus on innovation and quality of life. We were the first city in the country to roll out citywide gig-speed internet, and today that foundation supports everything from advanced manufacturing to tech startups….*"

[14] Advertising equivalency value is approximated by Meltwater's formula: X*0.025*0.37, where X is the reach or unique number of visitors for a specific article or source; 0.025 represents the standard error, assuming that, on average, about 2.5% of the audience will view a particular article; 0.37 is the typical estimated value of 37 cents for each visitor which can be customized to different viewer groups.

Appendix 3. Input-Output Modeling

IMPLAN (impact analysis for planning) was developed in the 1970's to provide county-level input-output models designed to meet the mandated need for accurate, timely economic impact projections of alternative uses of U.S. public forest resources. IMPLAN is a subset of a family of methods called social accounting models which are based on the foundational work of the economist Wassily Leontief. The models use detailed data on industry interactions, labor income, and household spending. Input-output models are used to demonstrate how different sectors of the economy are interconnected and can be used to predict the economic responses from alternative policy choices (e.g., building a new sports stadium). Such modeling is commonly used by the World Bank, the United Nations, and the U.S. Department of Commerce.

IMPLAN models how industries interact within an economy. It tracks the flow of goods and services between sectors, showing how output from one industry becomes input for another. The model allows us to see how a change in one part of the economy ripples across the entire economy by generating industry-specific and location-specific multipliers. In turn, these multipliers can be used to estimate the economic impact of alternative policies or changes in the local economy.

IMPLAN takes the total spending into the local economy by a particular industry and translates it into the total economic impact expressed in terms of employment, output, and government tax revenue. Output includes Value Added (Employee Compensation, Proprietor Income, Other Property Income, and Taxes on Production and Imports net of subsidies). The total economic impact is split into: (1) The direct effect of spending on wages and salaries plus purchase of goods and services, (2) the indirect effect of the business-to-business spending spurred by the original investment in goods and services, and (3) the induced effect from household spending on goods and services. This household spending arises because of the wages and salaries received by those employed by the focal business and other local businesses, and entrepreneurial income from the owners of local businesses. This involves spending on local goods and services, such as groceries, entertainment, and retail. The multipliers are specific to an industry and location.

IMPLAN's economic impact analysis is used to gauge the economic effects of a new investment in an industry. The industry contribution analysis (ICA), by contrast, is designed to examine how an existing industry supports or contributes to the economy in the defined region. Industry contribution analysis does not consider the initial investment in the industry and is more conservative than an economic impact analysis because it removes feedback linkages to the subject industry. ICA methodology in IMPLAN is based on the work of Miller & Blair (2009).

CHAPTER 4. SMART GRID EFFECTS

The World Economic Forum describes a smart grid as a highly distributed network of clean renewable energy deployed at the edge of the existing grid.[15] Energy flows omnidirectionally both to and from the source of generation, which renewable energy sources require, and the entire system is balanced for intermittent energy sources like solar and wind in real-time. This gives energy providers the flexibility to distribute energy where and when it is needed most, while giving customers the information needed to make environmentally conscious and cost-effective energy choices. The smart grid requires an advanced level of computing to be deployed at the edge of the grid to manage and optimize the highly distributed intermittent loads introduced.

The U.S. Department of Energy's (DOE) website, smartgrid.gov, points out that what makes a grid "smart" is the digital technology that allows for two-way communication between the utility and its customers and its critical equipment. Like the internet, the Smart Grid consists of controls, computers, automation, and new technologies and equipment working together. These technologies work with the electric grid to respond digitally to quickly changing electric demand. Fiber optic infrastructure is critical to the working of a smart grid.

With the advent of widespread Artificial Intelligence use, the demand for electricity has climbed as has the value of smart grids. They provide the vast amounts of real-time data that AI algorithms need to operate effectively. AI data centers are characterized by their high energy intensity and dynamic, unpredictable power fluctuations. Traditional grids were not designed for such demands, and this puts immense stress on the grid, potentially leading to instability. Smart grids, with their real-time monitoring and advanced control systems, can better manage these fluctuations ensuring grid stability and preventing disruptions. In concurrent developments, advances in Quantum Technology (QT) could magnify the work of AI at a fraction of the current energy cost. As discussed in Chapter 6, Chattanooga's Quantum Collaborative website says, "*Quantum is coming. Chattanooga will be ready*."

EPB's smart grid became fully operational in 2012. Since then, it has delivered operational savings to the utility and immense value to the community in terms of outages prevented and reductions in harmful emissions amounting to over **$1.09 billion** as seen in **Table 4.1**.

Table 4.1 Summary of Smart Grid Savings: 2014-2025	
Meter Read and Switching Cost Reductions	$29,830,571
Reduced peak demand savings	$38,412,900
Outages Reduced (non-storm)*	$313,741,039
Outages Reduced (major weather events)*	$631,800,000
Pollution reduction benefits	$492,390
Reduced power theft	$79,720,449
Total	$1,093,997,349
Notes: * from 2012	

[15] Traditional energy grids support a one-way flow of power from centralized sources, such as coal, nuclear and gas to points of consumption — homes, businesses and data centers. When more power is needed, another centralized source of generation, a power plant, has to be built. The traditional grid cannot quickly pivot in the face of acute demand spikes or support the 100% renewable energy critical to meet global climate goals.

4.1 Reduced Operating and Maintenance Costs

The utility has realized operational cost savings from planned switching events, remote enabled reconnects and customer disconnects, and the automation of meter reading technology. Through the implementation of automated switching technology there is less demand for utility workers to enter the field for identification and restoration of areas impacted by weather events, which are increasing in frequency (Lobo, 2020). The lower demand for field work means fewer truck rolls are needed, fewer miles are traveled, less fuel is used and labor costs are reduced. Note that data is only available from 2014.

As seen in **Table 4.2**, from 2014-2025, the net benefit of remote customer disconnects/reconnects, planned switching events and automated meter reads totaled **$29,830,571**.[16] The smart grid has enabled EPB to avoid approximately 5,226,963 travel miles. The reduction in miles driven is addressed later under pollution reduction effects.

Table 4.2 Meter Read and Switching Cost Reductions

	Meter Reads Avoided		Remote Disconnect/Reconnect		Planned Switching Events	
	# AMI Meters	# Miles Avoided	# Events	# Miles Avoided	# Events	# Miles Avoided
2014	2,092,032	251,044	-	-	6,577	13,154
2015	2,092,032	251,044	19,590	54,852	8,038	16,076
2016	2,092,032	251,044	46,806	131,057	10,613	21,226
2017	2,092,032	251,044	53,853	150,788	13,164	26,328
2018	2,144,442	257,333	57,052	159,746	10,592	21,184
2019	2,196,852	263,622	63,022	159,746	10,652	21,304
2020	2,196,852	263,622	49,635	176,462	12,279	24,558
2021	2,196,852	263,622	54,512	138,978	12,089	24,178
2022	2,196,852	263,622	75,650	152,634	13,375	26,750
2023	2,253,228	270,387	81,045	211,820	14,205	28,410
2024	2,359,978	283,197	74,311	226,926	15,594	31,188
2025	2,401,702	288,204	79,247	221,891	14,961	29,992
Total	26,314,886	3,157,785	654,723	1,784,900	142,139	284,278
Cost Reduction	**$18,420,420**		**$7,856,676**		**$3,553,475**	

Source: EPB. Assumptions: Cost per meter read = $0.70; cost per remote disconnect/reconnect = $12; cost per switch = $25; Cost per AMI work order = $9.87. Data for 2025 is through May.

4.2 Outage Reduced

The single largest benefit of the smart grid has been in substantially reducing outage minutes brought on either by a storm or other non-storm factors. During major and minor storms or disruptions of any kind, the smart grid enables a quick diagnosis and, often, a remote solution. Outages can be measured in terms of customer minutes and customer interruptions. For each electric outage, EPB records the number of customers affected and the length of the outage. The

[16] These benefits include the $14,074,513 estimated in the Lobo (2020) study, noting that the 2020 calendar year was only partially represented in that study.

number of customers affected multiplied by the length of the outage equals the "customer minutes" of outage. Customer Minutes Avoided is the number of minutes of outage that have been reduced due to the automation.

Since 2012, almost 390 million customer minutes (a combination of residential and commercial) have been avoided through smart grid technology (see **Fig 4.1** and **Table 4.3**).

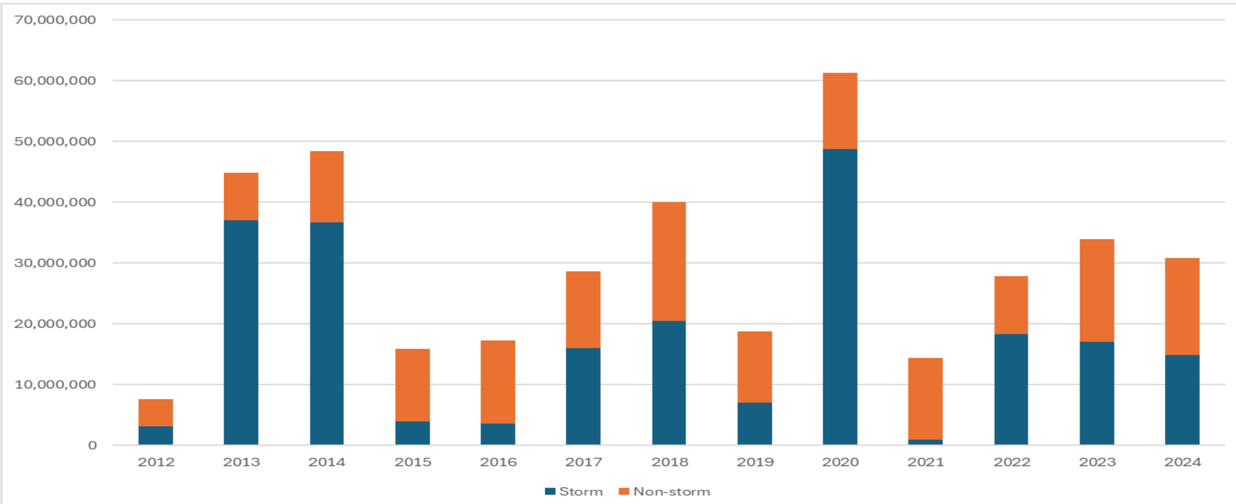


Fig. 4.1 Outage Minutes Reduced 2012-2024

Customer interruptions avoided is a combination of both customers that did not experience an outage and those that were automatically restored due to the smart grid. Many of these restorations would occur just seconds after an interruption to the grid thanks to the smart grid's IntelliRupters. Since 2012, over 4.20 million customer interruptions have been avoided.

Table 4.3 Electricity Outages Reduced

	Customer Minutes Avoided			Customer Interruptions Avoided		
	Storm	Non-storm	Total	Storm	Non-storm	Total
2012	3,096,757	4,570,752	7,667,509	31,505	83,607	115,112
2013	36,976,226	7,905,058	44,881,284	42,589	129,846	172,435
2014	36,633,684	11,741,673	48,375,357	45,774	195,032	240,806
2015	3,949,200	11,928,864	15,878,064	28,484	197,361	225,845
2016	3,628,740	13,631,310	17,260,050	29,687	205,090	234,777
2017	15,991,292	12,654,002	28,645,294	140,451	185,043	325,494
2018	20,487,050	19,526,335	40,013,385	298,864	258,133	556,997
2019	7,062,181	11,683,835	18,746,046	77,798	159,364	237,162
2020	48,710,321	12,610,680	61,321,001	131,329	182,393	313,722
2021	919,602	13,530,846	14,450,448	21,002	201,821	222,823
2022	18,299,292	9,540,358	27,839,650	238,510	122,081	360,591
2023	17,017,479	16,945,923	33,963,402	176,292	258,962	435,254
2024	14,870,597	15,900,567	30,771,164	163,287	241,681	404,968
2025	19,019,889	8,918,934	27,938,823	193,492	157,901	351,393
Total			417,751,477			4,197,379

Source: EPB. Customer interruptions are # customers interrupted per event. Data for 2025 is through May.

As in previous studies (Lobo, 2015, 2020), we use the DOE's Interruption Cost Estimate (ICE) calculator to calculate the economic effect of non-storm outage minutes and customer interruptions saved. The ICE calculator is designed to provide a snapshot of costs to customers (residential, commercial and industrial in different geographic footprints) of electric outages based on utility metrics such as System Average Interruption Duration Index (SAIDI), System Average Interruption Frequency Index (SAIFI) and Consumer Average Interruption Duration Index (CAIDI). The improvement in system efficiency can be gauged by the visual representation of EPB's performance relative to other power distributors in the nation seen in **Fig 4.2**.

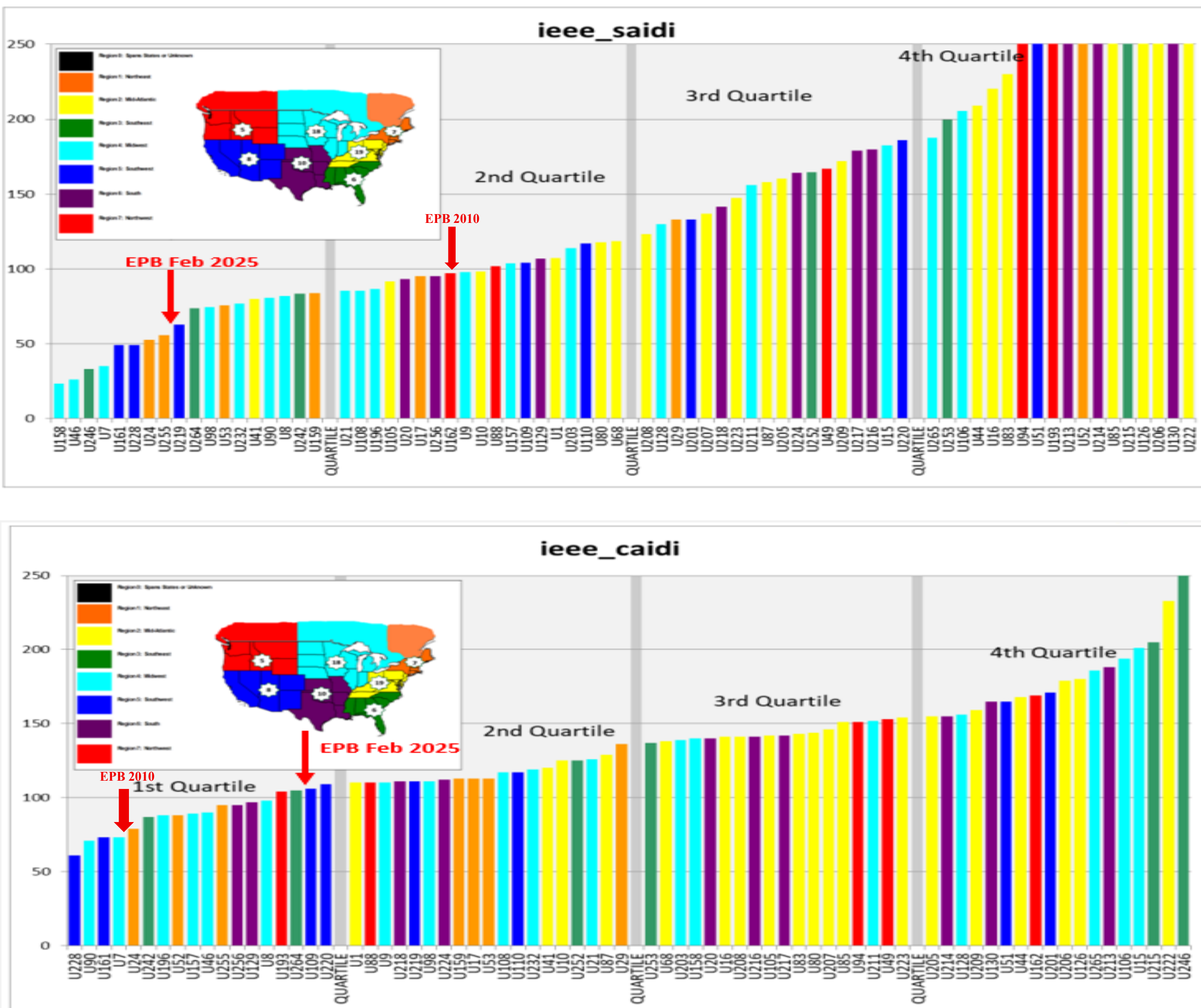


Fig. 4.2 EPB's SAIDI and CAIDI Quartiles

To derive the economic value of utility efficiency, i.e. outages and interruptions avoided, one would compare the ICE estimates from prior to automation relative to post-automation. We examine costs of outages/interruptions to customers at four points in time: June 2011 (before the smart grid became operational) and June 2015, June 2020, and June 2024 (after automation). These estimates are contained in **Table 4.4**.

Table 4.4 ICE Non-storm Outage Savings Calculator				
	SAIDI	SAIFI	Cost to Customers	Annual Cost Savings v 2011
June 2011(without automation)	112.00	1.42	$55,770,000	
2015 (with automation)	61.80	0.69	$28,971,000	$26,799,000
2020 (with automation)	72.30	0.61	$31,364,745	$26,648,969
2024 (with automation)	70.87	0.73	$27,940,559	$30,073,155
Total (with automation)				**$313,741,039**
Notes: Source: EPB. SAIDI = System Average Interruption Duration Index; SAIFI = System Average Interruption Frequency Index; Inputs needed are annual residential and non-residential customer counts. Total savings were estimated as follows: We apply the 2015 savings estimate for years 2012-2015 and the savings estimates from 2020 and 2024 for the periods 2016-2020, and 2021-2024, respectively.				

In 2024, the annual non-storm outage cost savings of the smart grid amounted to $30.07 million. The improvement in the system totals **$313,741,039** over the period 2012 to 2024.

Major weather events

The ICE calculator does not tell the whole story of utility efficiency because it does not factor in major weather events such as the tornadoes of April 2020.[17] A joint EPB-Oak Ridge National Lab study (Glass et al., 2015) of a major event on July 12, 2012 revealed that with automation, EPB was able to reduce customer outages by 56 percent and outage costs by 33 percent. The overall avoided cost from outages due to major events was estimated to be $23.4 million per event. At an average of two major weather events per year (totaling an average of 5-6 days of outages), the total benefit from smart grid automation during 27 major weather events amounts to **$631,800,000** over the period 2012-2025.[18]

4.3 Reduced peak demand

Smart Grid infrastructure allows utilities to deploy automated switching technologies and demand side management (DSM) programs that are aimed at shaving peak load, resulting in a reduction in the cost of power. Not only do DSM programs provide reliability and economic benefits, but they also reduce air pollution associated with a lower demand for energy.

Peak reduction data is available from 2014. With the smart grid, EPB was able to reduce peak demand by 25-30 MW per month and peak energy consumption by an average of 1-2 percent per month. For the period 2014-2025, the utility was able to shave 3,470 MW of demand and 15,868 MWh of electricity consumption as seen in **Table 4.5**.

To calculate the savings associated with peak demand reduction, we apply an average price of $11,070 per MW based on average TVA wholesale prices over the study period. The savings amount to **$38,412,900** over the period 2014-2025.

[17] A major weather event is defined as an event that causes 10% or more customers in a defined geographic district in the utility footprint to experience an outage.
[18] The National Centers for Environmental Information storm events database shows that there were 147 major storm days in Hamilton County from 2012 to 2025.

Table 4.5 Peak Demand, Energy and Pollution Reduction						
	MW Reduced	Cost of MW saved	MWh reduced	Pollutants reduced (tons)		
				CO_2	CH_4	N_2O
2014	269	$2,977,830	1,903	-549.965	-0.156	-0.010
2015	301	$3,332,070	2,183	-630.790	-0.179	-0.012
2016	303	$3,354,210	2,390	-690.800	-0.196	-0.013
2017	275	$3,044,250	1,743	-503.611	-0.143	-0.009
2018	310	$3,431,700	975	-281.907	-0.080	-0.005
2019	319	$3,531,330	1681	-485.727	-0.138	-0.009
2020	280	$3,099,600	876	-253.241	-0.072	-0.005
2021	290	$3,210,300	476	-137.607	-0.039	-0.003
2022	300	$3,321,000	668	-192.998	-0.055	-0.004
2023	240	$2,656,800	791	-228.739	-0.065	-0.004
2024	308	$3,409,560	1,191	-344.166	-0.098	-0.006
2025	275	$3,044,250	991			
Total	3,470	$38,412,900	15,868	-4,299.55	-1.22	-0.08
Notes: Data for 2025 is through May.						

4.4 Pollution Reduction

Additional environmental benefits can be attributed to the reduction in energy (MWh). In **Table 4.5** we show the amounts of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) reduced by lowering the amount of peak energy consumed each year.

EPB has engaged with Scope 5, a firm that provides data assistance and consulting services in relation to emissions across an enterprise's supply chain. Scope 5 and EPB have compiled data back to 2014 on emission reductions related to the Smart Grid across four distinct areas.

1) Demand Reduction: The Smart Grid allows for automated switching and demand side management (DSM) programs. This allows EPB to shave peak energy consumption, lowering the cost of power and reducing a range of energy related pollutants. Pollution benefits = $187,559.
2) Avoided Meter Reads: Smart meters on the grid allow for the automation of meter reads, reducing the need for manual meter reads at the premises. Pollution benefits = $185,897
3) Planned switching events: Pollution benefits = $16,573.
4) Remote Disconnect Under Glass (RDUG) Meters: RDUG allows EPB to remotely disconnect or connect a delinquent meter remotely in just 10 minutes. These meters limit the need for truck rolls for servicing meters that have unpaid bills or reconnection once a bill is paid. Pollution benefits = $102,360.

Across all four tracked areas, from 2014 to 2024, EPBs smart grid has resulted in a reduction of 11,367 tons of carbon-equivalent (CO2e).

Table 4.6 shows the reduction in emissions of carbon dioxide, methane and nitrous oxide due to reduced peak demand, avoided meter reads, planned switching events and RDUG. Based on the per ton cost of each of these pollutants, the aggregate socio-economic benefit of reduced pollution amounts to **$492,389**. [19]

Table 4.6 Pollution Reduction Benefits						
	Emissions Reduced (tons)			Value of Reduced Emissions		
	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
				$43/ton	$1,200/ton	$15,000/ton
2014	-944.47	-0.16	-0.02	($40,612)	($198)	($226)
2015	-1,109.60	-0.19	-0.02	($47,713)	($225)	($249)
2016	-1,288.37	-0.20	-0.02	($55,400)	($246)	($267)
2017	-1,137.55	-0.15	-0.01	($48,915)	($182)	($216)
2018	-930.61	-0.09	-0.01	($40,016)	($107)	($154)
2019	-1,168.36	-0.15	-0.01	($50,240)	($177)	($213)
2020	-829.05	-0.08	-0.01	($35,649)	($98)	($148)
2021	-868.17	-0.05	-0.01	($37,331)	($58)	($116)
2022	-953.67	-0.06	-0.01	($41,008)	($77)	($132)
2023	-1,012.55	-0.08	-0.01	($43,540)	($90)	($147)
2024	-1,123.99	-0.11	-0.01	($48,331)	($130)	($181)
Total	-11,366.39	-1.32	-0.14	($488,755)	($1,587)	($2,048)
Source: Pollutant estimates from Scope 5 as provided by EPB. Cost estimates from Marten et al (2015)						

4.5 Reduced Costs from Theft

Remote meter reading allows for more frequent identification of electricity theft. EPB estimates this benefit to be roughly one percent of annual revenues or **$79.7 million** over the period 2012-2024 (see **Table 4.7**).

Table 4.7 Power Theft Reduction					
Year	Electric Revenues Thousands	Theft Reduction 1%	Year	Electric Revenues Thousands	Theft Reduction 1%
2012	$558,125	$5,581,250	2019	$570,576	$5,705,760
2013	$552,627	$5,526,270	2020	$531,285	$5,312,850
2014	$564,623	$5,646,230	2021	$532,950	$5,329,500
2015	$553,139	$5,531,390	2022	$580,606	$5,806,060
2016	$549,421	$5,494,210	2023	$609,294	$6,092,940
2017	$567,035	$5,670,350	2024	$613,301	$6,133,010
2018	$567,058	$5,670,580	2025#	$622,049	$6,220,049
			Total		**$79,720,449**
Source: EPB Annual Reports and author calculations. # Estimate.					

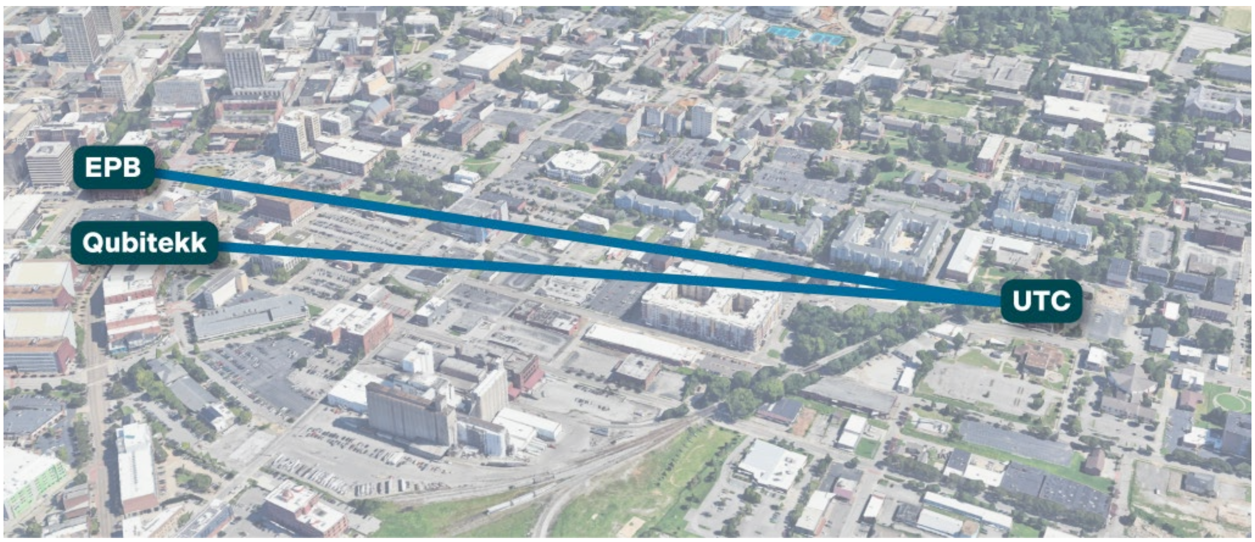
4.6 Ongoing and Future Developments

EPB has continued its relationship with the DOE and Oak Ridge National Laboratory (ORNL) with renewed partnership and efforts in both energy and quantum applications. In 2024, EPB and

[19] This estimate is calculated differently from Lobo (2015) because costs of pollutants were not readily available in 2020.

ORNL announced a new initiative, the Collaborative for Energy Resilience and Quantum Science (CERQS) to utilize the energy and communications infrastructure in Chattanooga to *"develop technologies and best practices for enhancing the resilience and security of the national power grid while accelerating the commercialization of quantum technologies."* EPB and ORNL have worked together over the years on almost 30 funded projects from energy models for power optimization to dynamic microgrids.

CERQS was established with 4 strategic goals: 1) National leadership in quantum science and technology 2) Energy security innovation 3) Workforce development 4) Economic development. In September 2024, ORNL began testing a technology that looked to maintain quantum data across a network for the first time. The Automatic Polarization Compensation (APC) technology was developed by ORNL scientists. The University of Tennessee at Chattanooga (UTC) was also part of the effort and is the first American university with a permanent connection to a commercial quantum network (see graphic below from ORNL).



EPB continues to explore other applications of its smart grid including microgrids with flexible boundaries, networked microgrids, optical sensors for substations, battery energy storage, and unmanned aerial vehicles to name a few. In 2023, EPB and the City of Chattanooga completed the "Power to Protect" microgrid at the Chattanooga Police Services Center and the Fire Department administrative headquarters. The microgrid includes a 200 kW diesel generator and 155 kWs of solar panels on the roof of the buildings. A 500 kW battery is included in the microgrid and allows for peak shaving during periods of extreme heat or cold, with batteries charged during hours of normal conditions. The microgrid has the capacity to generate and supply power 24/7/365 allowing for continued operations of essential police and fire services.

EPB's battery storage initiatives were awarded a grant from the U.S. Department of Energy in 2023 for $32.4 million as part of the Grid Resilience and Innovation Partnership (GRIP) grant program. EPB will match Federal funding dollar for dollar to add energy storage solutions to the Smart Grid, transition overhead power lines to underground and replace aging power poles where needed. This grant will provide the area with improved grid reliability, an improved smart grid, and more resiliency across the service area.

In 2019, the Chattanooga Metropolitan Airport became the first airport in the United States to run entirely on solar power. The 2.64 megawatt (MW) solar farm generates enough green electricity to account for the airport's total energy needs. It uses onsite batteries to help power operations at night and is expected to last 30 to 40 years. Officials from nearly 50 airports around the globe have visited or contacted the Chattanooga airfield in recent years to learn about its solar operations. Simultaneously, EPB and its partners have developed a microgrid with dynamic boundaries for the Chattanooga Airport that will link into existing automated switch gear and hence to the utility's smart grid network. This microgrid uses EPB's distribution system with multiple interconnect points to supply customer loads and can be configured based upon the customer load forecast, the solar photovoltaics (PV) generation forecast and the battery state of charge. The microgrid incorporates a 560-kW battery, which EPB owns and operates, with 2.1 MW of existing solar PV at the airport.[20] In addition to EPB's automated switch gear, the Chattanooga Airport microgrid uses EPB's fiber optic broadband communications network to transport data and for both human and machine-to-machine communications - between the microgrid controller and automated switches.

Improvements to both the smart grid and fiber infrastructure have been ongoing since the deployment of the system. EPB has invested $70 million to upgrade the fiber services with NOKIA PON25 technology allowing up to 25 gig broadband service on top of the previous network electronics upgrade which enabled gig speeds. EPB has also invested $4.5 million in the EPB Quantum Network, offering the nation a commercially available network. Starting in 2025, EPB is investing an additional $30 M in the IonQ Forte Enterprise Quantum Computer, bringing another layer to the quantum system in Chattanooga. Investments in quantum will allow for deeper analysis and understanding of the smart grid in the future.

EPB plans to improve the smart grid in the future with the addition of up to 150 MW of energy storage solutions and up to 65 MW of generation assets, representing 5% of EPB's peak as allowed by TVA. These additions will improve grid reliability and result in demand reduction and potential energy cost reductions.

[20] The other project partners include the University of Tennessee-Knoxville, the TVA, the Electric Power Research Institute (EPRI), National Instruments and the Green Energy Corporation. The Advanced Research Projects Agency-Energy (ARPA-E), a U.S. research and development agency, is the project's primary source of funding.

CHAPTER 5. COMMUNITY EFFECTS

In discussing the effects of high-speed broadband in the local community, we follow the National Telecommunications and Information Administration (NTIA) framework that conceptualizes the effects of high-speed broadband. In the current study, the values associated with these community pockets are subsumed in the contribution analysis presented in Chapter 3.

5.1 Government Services and Public Safety

High-speed internet helps government agencies improve quality, lower costs and increase transparency by improving internal operations and making it easier for residents to interact with them online.

The city of Chattanooga uses a gigabit VLAN service through EPB. Apart from two server racks, the city's servers are cloud-based and cyber-secure. The city also uses a colocation service from EPB for disaster recovery purposes that provides redundancy and positions the city well for times when bandwidth needs to be ramped up (Lobo, 2020). The 25-gig capacity enables city officials to plan without bandwidth or latency constraints. The city is considering connected vehicles as part of the smart mobility initiatives, smart lighting platforms to control lighting at accident sites and placing cameras on refuse trucks to enable early detection of road problems. The fiber backhaul makes the processing and storing of such vast amounts of data feasible and efficient.

The Police Department and Public Works are among the largest users of bandwidth. The Real Time Intelligence Center that the Chattanooga Police Department gets to use, in conjunction with local businesses and apartment complexes, is very bandwidth intensive. Public safety cameras were first installed in June 2017. With the cameras, evidence is easier to gather, and crime files can be closed more rapidly (Lobo, 2020). The Department of Transportation also deploys cameras at traffic intersections as part of the Intelligent Transportation System to detect traffic patterns and prevent accidents and unnecessary pollution.

In 2020, Chattanooga was named the winner of the North America Smart Cities Award in the "*Police and Law Enforcement and Emergency Management*" category. In particular, the project *"911 Project – Predicting Hotspots for Accidents,"* co-produced by The Chattanooga Smart Community Collaborative and UTC's Center for Urban Informatics and Progress (CUIP), was the reason. The project was a response to an increase in traffic accidents and fatalities that made roadway accidents the leading cause of death for residents under the age of 55. CUIP uses the MLK Smart Corridor as a smart city and connected vehicle testbed. The testbed is being used for pedestrian safety, connected vehicle/infrastructure, and wireless connectivity projects. Over the 15-year service period of the project, the City is expected to significantly improve public safety and receive considerable benefits in fuel savings of approximately 86 million gallons.

5.2 Smart City

The fiber infrastructure has been a cornerstone of Chattanooga's efforts to transform into a leading smart city. Ultra-fast and reliable internet is essential for smart city technologies that rely on real-time data transmission. The fiber network supports a smart electric grid that improves power reliability and efficiency, enables real-time monitoring, automated outage detection, and faster restoration of service. This has significantly reduced the cost and frequency of power outages. Moreover, fiber-enabled technologies help improve transportation safety and efficiency via connected vehicle-to-everything (C-V2X) systems and adaptive traffic signals which enable real-time traffic management to reduce congestion and emissions.

The Center for Urban Informatics and Progress (CUIP) is a smart city and urbanization research center at the University of Tennessee at Chattanooga. Using the power of big data, artificial intelligence, statistical modeling, machine learning, and more, researchers work on problems dealing with how cities can adapt to our generation's challenges to ensure that our future is safer, smarter, and healthier for all. Their applied research efforts pioneer ways to improve traffic flows, reduce vehicle and pedestrian accidents, reduce carbon emissions, optimize healthcare patient outcomes, and more.

The CUIP website says:
"*The city of Chattanooga has emerged as a pioneer in urban renewal and sustainable development. As part of this renewal an extraordinary infrastructure has been put in place that includes high-speed, high bandwidth information networks that connect a large number of citizens to the internet. This infrastructure provides the foundation for the collection and exploitation of large amounts of heterogeneous data intended to improve city services. It allows for more effective transportation systems, energy efficiency, production and delivery, and for improving quality of life in general, including human wellness and health management and care delivery.*"

UTC hosts a **citywide smart city testbed** that spans over 120 signalized intersections. Each intersection is equipped with IoT devices, C-V2X communications, edge computing, and various sensors, offering an unparalleled environment for conducting cutting-edge research. This extensive infrastructure supports numerous research projects and collaborations, facilitating innovative solutions to urban transportation challenges and fostering advancements in intelligent transportation systems.

The **Smart Mobility Lab** focuses on enhancing urban mobility. It includes a mock intersection equipped with the same technology deployed throughout the city allowing researchers to test and validate their work in a controlled environment before field deployment. The Lab serves as a vital resource for developing and refining technologies that improve traffic flow, safety, and efficiency in urban areas. Connected and Automated Vehicles (CAVs) use advanced sensors, communication systems, and autonomous driving capabilities to improve traffic management and enhance road safety. Multi-modal transportation systems integrate various forms of transport, such as buses, trains, bicycles, and ride-sharing services, providing seamless, efficient, and flexible travel options. Safety remains a cornerstone of smart mobility initiatives, with cutting-edge systems constantly monitoring and responding to potential threats, ensuring a safer transportation ecosystem for all users.

In 2021, CUIP's innovative *Pedestrian Analysis* project was a winner of the Smart 50 Award, placing the project in the Top 50 in the world for the third straight year. A collaboration with Korea-based Seoul Robotics, Ouster, a San Francisco manufacturer of the 3D-object detection technology known as LIDAR, and the Chattanooga Department of Transportation, the project employs MLK Smart Corridor sensors to predict and reduce vehicle crashes at various intersections in Chattanooga and improve pedestrian safety citywide, using East Martin Luther King Boulevard as a starting point.

Intelligent Transportation Systems (ITS) focuses on modern transportation management. Traffic signal optimization leverages real-time data and adaptive algorithms to enhance traffic flow, minimize delays, and ensure the safety of vulnerable road users such as pedestrians and cyclists.

5.3 Telework

High-speed, low-latency internet allows teleworkers opportunities to more readily live and work in locations of their own choosing, without having to be within commuting distance of a corporate center or another base location. Telecommuting can improve environmental factors by reducing cold starts, emissions, and miles traveled. Measurable benefits also stem from savings in travel time and transportation costs (Lobo, 2015).

Chattanooga's citywide fiber network, operated by EPB, delivers symmetrical multi-gigabit internet speeds to homes and businesses. With ultra-low latency and minimal downtime, this network enables essential real-time collaboration and virtual meetings, seamless video conferencing, cloud computing, and large file transfers critical for remote work.

The pandemic of 2020 resulted in a surge in work from home (WFH) or telework. By May 2020, about 35 percent of U.S. workers were working remotely full-time, up from just 6 percent in 2019. Sectors like tech, finance, education, and professional services transitioned fastest. Migration to smaller, affordable and picturesque locales, such as Chattanooga, picked up.

As vaccines rolled out and restrictions eased, some companies began return-to-office mandates. However, hybrid models became the new norm. By 2023, about 28 percent of workdays were still remote. Buckman et al. (2025) estimate that WFH accounts for a quarter of paid workdays among Americans aged 20-64. The estimate is higher for those with children under eight and higher for women than men. Of these, some 36.7 percent worked 40+ hours per week from home. Even though telework has not returned to pandemic levels, a USA Today poll showed that 58 percent of white-collar workers prefer to work remotely at least 3 days a week and 42 percent would take a 10 percent pay cut for remote flexibility.

According to the City of Chattanooga's 2024 Internal Audit Report, 30 percent of city employees routinely telecommute (i.e., work remotely on a regular basis) and 10 percent of city employees occasionally telecommute (i.e., work remotely on an ad hoc basis). Data from the American Community Survey (ACS) shows that the WFH percentage of employees in Chattanooga has doubled to over 12 percent in 2023 compared to pre-pandemic 2020, in line with the national average (See **Fig. 2.2**). The uptrend in Chattanooga contrasts with the downtrend in the rest of the country.

Roughly 181,222 workers in Hamilton County who were 16 years and older commuted to work each day in 2023, according to the U.S. Census. Of these, 87 percent drove alone, carpooled, used public transport, or walked. The mean commute time to work in Hamilton County TN was 21.9 minutes, implying a round-trip travel distance of 36.2 miles each day at a speed of 50 miles per hour.

Some 23,461 or 12.9 percent of Hamilton County workers telecommuted or worked from home. The 2023 Urban Mobility Report from the Texas A&M Transportation Institute (TAMTI) shows that in 2022 Chattanooga commuters experienced a return to near pre-pandemic congestion levels.[21] The annual traffic delay (in hours) was 12.6 million hours (roughly 32 hours per commuter). The annual congestion cost was $327 million in Chattanooga. Efforts to transform the city into a Smart City could do much to reduce these costs.

5.4 Education and Remote Learning

Technology can be a powerful tool for transforming learning. But if the coronavirus crisis has made anything clear, it is that technology is an empty promise without connectivity.

A New Zealand study on the effects of high-speed broadband on education pointed to savings stemming from lower costs of skill enhancement, as well as reduced cost of course materials and savings on field trips. The result was a $3.6 billion consumer surplus over 20 years. More recently, a study out of Michigan State University's Quello Center revealed that poor internet connectivity has repercussions that go far beyond the ability to complete homework assignments (Hampton et al, 2020). In many cases, students will possibly be disadvantaged for life. Moreover**,** students who cannot access the internet from home do worse in school and are less likely to attend college or university**.**[22]

When COVID-19 made regular school impossible, EPB worked with the schools to provide hotspots in select neighborhoods to enable connectivity. On July 29, 2020, **HCS EdConnect** was announced as a new initiative to provide internet services to about 28,500 economically challenged students in Hamilton County Schools in the Greater Chattanooga area.[23] Families in the EPB service area with students who participate in HCS EdConnect would receive a router and at least 100 Mbps internet service at no charge. This internet service was at least four times faster than typical educational access offerings from other providers, and it was the only one that delivered symmetrical speeds with no data caps.

Now in its fourth year, HCS EdConnect reaches more than 16,000 students, who, with their families, represent over 28,000 Chattanooga area residents. The program has been hailed as a national model because it guarantees year-round internet access at no charge to every family with students in need for at least 10 years – with plans to raise more funds as needed to maintain the program indefinitely.

In a survey of families enrolled in the program, a Boston College study found that parental involvement remains consistently strong even after four years. Participants use their connectivity

[21] TAMTI measures the benefits of telecommuting by providing cost estimates of traffic congestion and accidents in terms of wasted fuel, productivity loss and healthcare costs.
[22] Dettling et al. (2015) link the diffusion of zip code-level residential broadband internet to millions of PSAT and SAT takers' college testing and application outcomes and find that students with access to high-speed internet in their junior year of high school perform better on the SAT and apply to a higher number and more expansive set of colleges.
[23] Funding partners include Hamilton County, the City of Chattanooga, BlueCross BlueShield of Tennessee Foundation and the Smart City Venture Fund, which includes the Benwood Foundation, the Community Foundation, the Footprint Foundation and the Robert L. and Kathrina H. Maclellan Foundation. The project is also funded under a contract with the State of Tennessee. The Enterprise Center provides logistical and operational support.

for school coursework, online learning, parent-teacher interactions, applying for jobs, remote work options and telehealth. In 2023, they found students with stronger home internet connections were more inclined to utilize the internet for learning new concepts and accessing information, which led to changes in their perspectives, in contrast to those with merely decent or poor connections.

The study concludes, "*Households enrolled in the EdConnect program are using digital devices as much or more frequently than other households to support their children's education through practices like getting information about homework, accessing grades and communicating with teachers*."

5.5 Healthcare and Accessibility

Broadband-enabled telehealth encompasses real-time remote patient consultations, remote monitoring of patients' vital signs and conditions, the storing and forwarding of critical health information for analysis and diagnosis (e.g., MRI results and electronic health records), the provision of specialized services over long distances, the wide availability of health information to patients and caregivers, and access especially to medically underserved populations (Lobo, 2020).

Bauerly et al. (2019) point out that internet connectivity, particularly access to broadband, is playing an increasingly important role in healthcare and public health. To the extent that broadband access affects socioeconomic factors such as education and employment, both of which have important implications for health outcomes, they characterize broadband access as a "*super-determinant*" of health. This conclusion is especially meaningful given that the United States is expected to face a shortage of between 54,100 and 139,000 physicians by 2033, especially surgical specialists, pathologists, neurologists, radiologists, and psychiatrists (Boyle, 2020).

The CDC estimated that telehealth had the potential to save billions of dollars in healthcare expenditures. Saharkhiz et al. (2024) analyzed the impact of telehealth expansion during the COVID-19 pandemic on Medicare beneficiaries. They found that increased telehealth use was associated with reduced hospitalizations and emergency department visits, increased clinician encounters, and lower total cost of care per beneficiary, especially in high-telehealth-use areas. Patel et al. (2024) estimated the indirect cost savings (e.g., travel, time off work) for non-elderly cancer patients and found that telehealth significantly reduced out-of-pocket and opportunity costs especially for patients in rural or underserved areas.

COVID-19 had a profound and lasting impact on telehealth usage in the U.S. By mid-2020, telehealth accounted for up to 30.2 percent of all health center visits. Currently, utilization hovers around 20–24 percent of adults monthly. The telehealth market grew from $85 billion in 2023 to $110 billion in 2024, and is now in many ways a routine part of clinical care especially in family medicine, behavioral health, and chronic disease management. Consumer acceptance has risen sharply, with 70 percent of U.S. patients using telehealth at least once in 2023. In 2024, telehealth accounted for approximately 4.9 percent of all medical claim lines in the South (a proxy for Chattanooga) according to the Monthly Telehealth Regional Tracker, which uses FAIR Health data. The top diagnostic categories for telehealth visits included: mental health conditions (e.g., anxiety, depression), general medical consultations, endocrine and metabolic disorders. Mental health continues to dominate telehealth usage, with depression and anxiety being the most common diagnoses.

Effective telehealth, however, is only possible with high-speed, low-latency broadband connectivity. Willingness-to-pay (WTP) for telehealth is influenced by income, education, perceived benefits, health status, and experience (Steigenberger et al, 2022). Chang, Savage and Waldman (2017) determined that the average household was willing to pay about $52.68 more per year for internet service (relative to what they were paying) that gave them the ability to receive remote diagnosis, treatment, monitoring and consultations.

Locally, Regional Obstetrical Consultants (ROC), a high-risk obstetrics practice in Chattanooga pointed out that each teleconsultation takes about 15 minutes less than a normal 45 to 60 minute face-to-face consultation/visit, and telemedicine patients miss fewer appointments compared to in-person patients, i.e. the no-show rate was less than one percent compared to 12 percent for in-person appointments at the main office (Lobo, 2020).

The higher bandwidth has other uses in the medical field. Lobo (2020) reported on the value to radiologists who send and receive multiple image files, each around 80 to 100 megabits in size. The multi-gig bandwidth available in Chattanooga saves time and money and promotes efficiency.

5.6 Entertainment

High-speed broadband is essential to enjoying 21st-century entertainment (see **Fig 5.1**).[24] Technologies like 4k and 8k video streaming, online gaming and e-sports, and connecting with friends and relatives via social media are only possible because of high-speed, low latency broadband. The bandwidth supports multiplayer online gaming and cloud gaming platforms like Xbox Cloud Gaming and NVIDIA GeForce NOW. High-speed, low-latency connections enable immersive VR/AR experiences for gaming and virtual concerts.

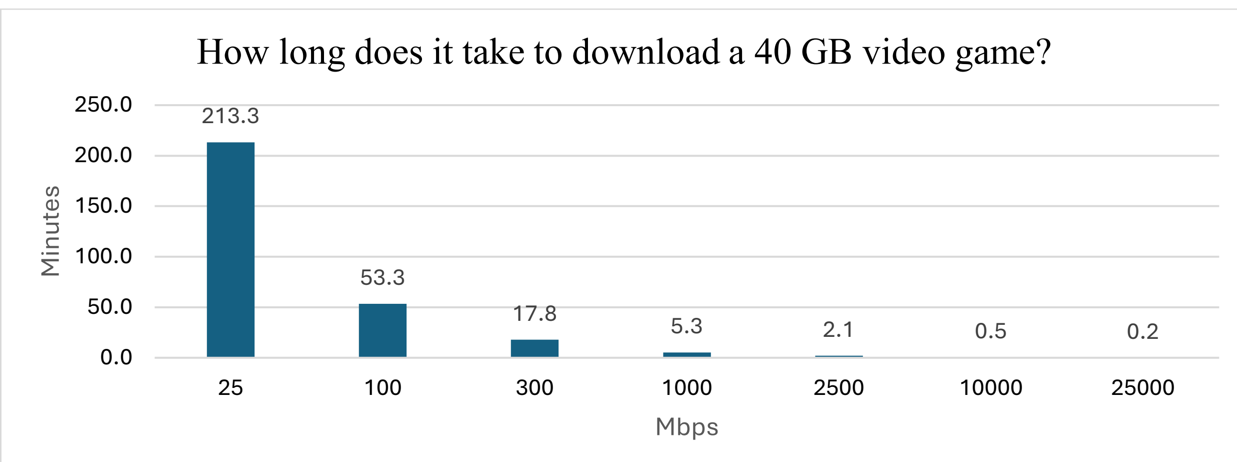


Fig. 5.1 Download time for a 40 GB video game

[24] See Calculator.net for bandwidth speed calculations.

EPB's 25 Gig Internet Service (launched in 2022) makes Chattanooga the first city in the U.S. to offer community-wide 25,000 Mbps internet, enabling seamless 4K/8K streaming, live event broadcasting, and multi-device usage without buffering. The infrastructure has helped attract digital media startups (such as *LegacyBox*, *Text Reques*, and *True North Custom*)[25] and small indie game developers, contributing to Chattanooga's growing tech and entertainment economy. The Chattanooga Convention Center became the first in the world to offer 25 Gig service, attracting e-gaming competitions, live streaming events, and digital media conferences, boosting local entertainment and tourism.[26]

Given the expected sharp increase in connected devices per household by 2030 (see **Appendix 2**), the multi-gig infrastructure in Chattanooga seems poised to be a cornerstone of life in the region and a source of significant business efficiencies and consumer surplus.

[25] *Legacybox* converts analog media (tapes, film, photos) into digital formats. *Text Request* is a business texting platform used for marketing, customer service, and internal communication. *True North Custom* specializes in HIPAA-compliant digital content and marketing for healthcare brands.

[26] The launch of the new internet service in August 2022 was a result of EPB's multi-year effort to upgrade the whole community-wide network from core to the optical networking equipment at customer locations with the latest optical signaling technology along with the deployment of Nokia's ground-breaking symmetrical 25G PON (Passive Optical Network) fiber broadband technology. EPB can provide 25 Gig internet services anywhere across its network while avoiding the need for one-off, point-to-point installations.

CHAPTER 6. QUANTUM CITY

6.1 From Gig to Quantum

In 2022, the nation's first commercial quantum network, known as the EPB Quantum Network℠ was established. This network leverages Chattanooga's advanced fiber-optic infrastructure to support quantum computing and networking. The EPB Quantum Network℠ aims to accelerate the commercialization of quantum technology (QT), aligning local job creation efforts with national priorities. The quantum initiative at EPB is housed in the newly created Strategic Initiatives division.

A key partnership in Chattanooga's quantum computing initiative is with IonQ, a leading pure-play quantum computing company. In 2021, EPB partnered with IonQ to bring its state-of-the-art *Forte Enterprise* quantum computer to Chattanooga, further enhancing the city's quantum capabilities. This partnership is part of the broader Chattanooga Quantum Collaborative (CQC), which includes government, business, and nonprofit groups working together to promote QT development.

CQC CEO, Charlie Brock, said, "*We hope to be a collaborator, a convener and connector to help take the infrastructure that EPB has built and work to commercialize this unique quantum network we have here. We want to get out in the market and help bring in, start up and scale up businesses that are in the quantum supply chain which could benefit by the quantum network here….*" Chattanooga will be a place where new discoveries and technologies can be tested in real-world situations on the quantum network.

The growth in the quantum space is expected to come from advancements in various fields, including:

- Cybersecurity: Quantum key distribution (QKD) can enhance the security of communications and protect critical infrastructure such as the smart electric grid.
- Artificial Intelligence: Quantum computing can accelerate machine learning algorithms, leading to more advanced AI applications.
- Advanced Computing: Quantum computers can solve complex problems faster than classical computers, enabling breakthroughs in fields such as materials science, drug discovery, and logistics.

The UTC Quantum Center

Launched in 2022, the UTC Quantum Center, is the focal point for a program in Quantum Information Science and Engineering (QISE) that involves departments and colleges across the university with key efforts in R&D infrastructure, education, use-case-driven R&D, and business development.

Dr. Rick Mukherjee is the director of the center and Dr. Tian Li is its Chief Technology Officer. They plan to elevate UTC's quantum physics and technology research profile and create a pipeline of high-skill talent to populate the local workforce.

In 2023, UTC became connected to the EPB Quantum Network℠. In addition, UTC established infrastructure to support Quantum Sensing and Communications and access to Quantum Computing systems. A four-course certificate in QISE is now offered to undergraduate students.

Quantum computing courses are offered at undergraduate and graduate levels. The UTC Center for Professional Education offers a non-credit certificate in introduction to QISE.

Quantum Economic Development Consortium (QED-C)
QED-C was established with support from the National Institute of Standards and Technology (NIST) as part of the Federal strategy for advancing quantum information science and as called for by the National Quantum Initiative Act enacted in 2018. It is a consortium of stakeholders that aims to enable and grow the quantum industry by working together to identify gaps in technology, standards, and workforce and to address those gaps through collaboration. Both UTC and EPB are members of this consortium.

QED-C serves as a one-stop shop for information offering a broad industry perspective and releases regular studies on various aspects of the quantum industry, including the State of the Quantum Industry Report referenced in this study.

6.2 The Potential

Quantum technology encompasses the three subfields of computing, communication, and sensing:

- **Quantum computing** (QC) is a new computing paradigm leveraging the laws of quantum mechanics to provide significant performance improvement for certain applications and enable new territories of computing compared to existing classical computing.
- **Quantum communication** (QCOMM) refers to the secure transfer of quantum information across distances and could ensure security of communication even in the face of unlimited (quantum) computing power.
- **Quantum sensing** (QS) refers to a new generation of sensors, based on quantum systems, that provide measurements of various quantities (e.g. electromagnetic fields, gravity, time) and are orders of magnitude more sensitive than classical sensors.

A quantum computer leverages quantum mechanics, a fundamental branch of physics that describes the behavior of matter and energy at the smallest scales — typically at the level of atoms and subatomic particles. Quantum mechanics underpins much of modern technology, including semiconductors, lasers, MRI machines, and quantum computing. It also forms the basis for fields like quantum chemistry and quantum information science.[27]

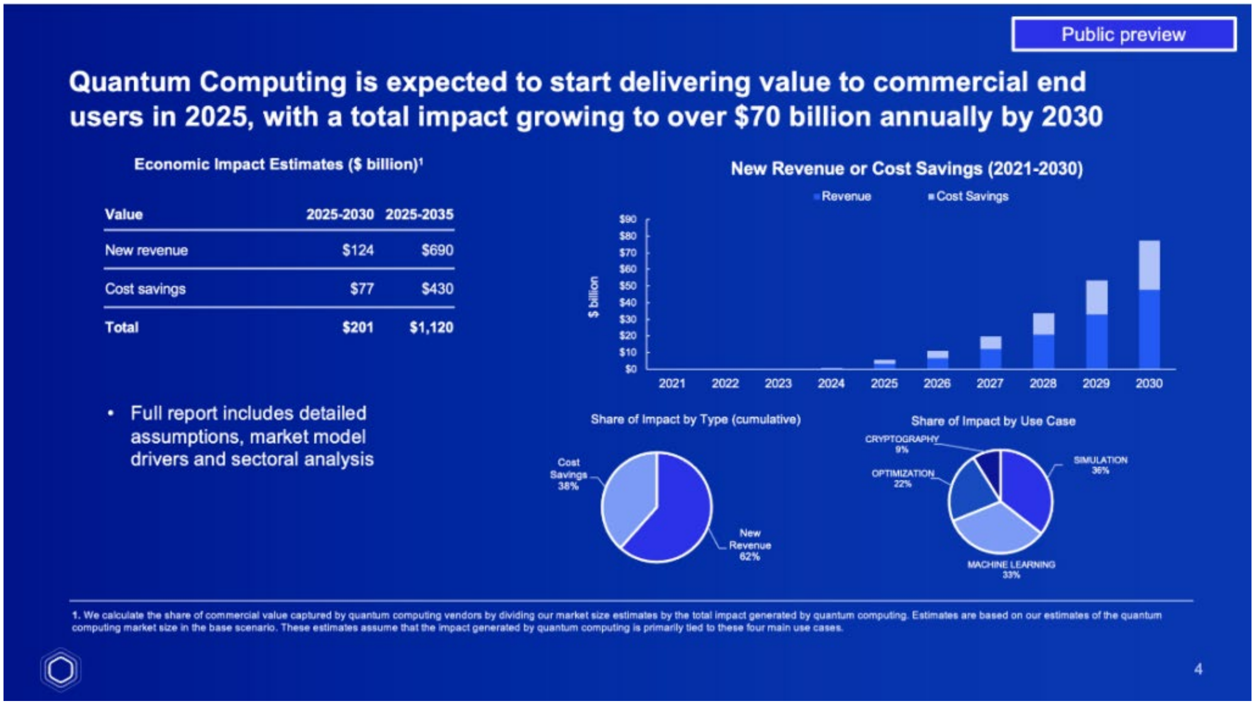
The processing power of quantum computers can be, in principle, exponentially greater than that of classical digital computers. They can handle complex problems in fields such as mathematics, chemistry, biology, weather forecasting, finance, encryption, cybersecurity and transport logistics. Quantum computers are still in their early development stage, but they are capable of running algorithms that would take several orders of magnitude longer if implemented with conventional computers. In artificial intelligence, quantum computers can be used to train machine learning models much faster than classical computers.

Quantum networking is poised to become a cornerstone of secure global communications and distributed quantum computing. As cybersecurity needs increase, Quantum networks will be able to offer unbreakable encryption through QKD. This is increasingly vital as classical encryption becomes vulnerable to quantum computing. Telecommunications, hyperscalers, and cybersecurity

[27] For more on quantum mechanics, see Kumar and Kumar (2023).

firms are rapidly adopting quantum networking technologies, expected to make up 16-26 percent of the market by 2035 (McKinsey, 2025).[28]

Quantum networking will be a key enabler of the broader quantum economy, which is projected to contribute $1 trillion in value creation across industries like finance, defense, and telecom by 2035 according to Quantum Insider (see graphic below).[29] A quantum global internet could be achievable with quantum network infrastructure.



Q-Day is coming

Q-Day refers to the point at which quantum computers can break classical encryption, exposing sensitive data and creating an urgent need for quantum-safe security measures. Sensitive data using legacy encryption becomes vulnerable, leading to potentially large economic and societal disruption.

Q-Day could be a critical shift in security strategies, requiring early adoption and potential partnerships with early movers in QComm and networks. Q-Day is expected to have a strong impact on industries that are highly reliant on cryptography but have lower crypto-agility such as financial services, healthcare, aerospace and defense, insurance, and government security.

The *2025 QED-C State of the Quantum Industry* report states that as of 2024, there were more than 6,000 entities working in the quantum space: 513 companies focusing solely on quantum technology ("pure-play" companies) and 5,989 organizations that dedicate a portion of their resources to quantum technology (this group includes many universities, laboratories, and established technology companies). Across all quantum-related companies, 37 percent are focused

[28] Governments are expected to remain the largest customers, accounting for up to 66% of the market in 2023, with continued dominance through 2035 due to national security priorities.
[29] Seamless integration with classical networks and cloud infrastructure will be essential for widespread adoption. International standards and regulatory frameworks will shape the pace and scope of deployment.

on quantum hardware components, 15 percent on software, and 15 percent on quantum communications and security. Smaller percentages focus specifically on quantum imaging and sensing (9 percent) and quantum computers (6 percent). In 2024, private venture capital investments in the quantum industry reached a record high of $2.6 billion, after a drop-off in 2023. The majority of this funding, nearly $1.7 billion, was raised by U.S.-based quantum companies.

The report estimates that more than 14,500 professionals now work at pure-play quantum companies. About 25 percent of these professionals work in engineering, 12 percent in information technology, 12 percent in research, and 12 percent in business development. Across all types of organizations, there are estimated to be 200,000 people in the quantum workforce.

QED-C executive director Celia Merzbacher had this to say, "*The quantum economy is here to stay — with growing revenues and investment, as well as high-skilled jobs in companies across the quantum 'stack'… the advances being made by today's top quantum innovators are incontrovertible. With nearly $1.5 billion in 2024 revenue from the quantum computing and quantum sensing industries and predicted annual growth of approximately 25 percent in the coming years, it is clear the quantum economy is real and on track to make significant impact across multiple sectors. To narrow the gap between the current stage of the industry, and a future where revenues sustain the innovation flywheel, public and private investments will be essential. As markets grow, so too will a diversity of products, a robust quantum supply chain, and a highly trained quantum workforce….*"

A 2024 Boston Consulting Group analysis for the Chicago Quantum Exchange (CQE) projects that by 2035 quantum technology providers in Illinois, Wisconsin, and Indiana alone could generate $60 billion in economic value. End users adopting quantum technologies could generate $20 billion more. This growth is expected to create as many as 191,000 quantum technology jobs by 2035, with a significant portion (over 70 percent) being open to individuals without graduate degrees.

A 2025 study of the potential economic impact of quantum technology in South Carolina using IMPLAN modeling points to potentially a 5.7 percent increase in firm productivity, an increase of 20,000 in the employment base and an increase of $8.5 billion in annual economic output. Fifty-five percent of this output bump would be from firms adopting quantum technologies, and 45 percent due to multiplier effects.

6.3 Use Cases

Table 6.1 contains examples of current use cases in the quantum industry.

Table 6.1 What problems can quantum technology solve?

Technologies	Description	Key Benefit
Quantum Key Distribution (QKD)	Secure encryption key exchange	Unbreakable encryption
Entanglement Distribution	Core for teleportation and networking	Long-distance quantum links
Distributed Quantum Computing	Joint computation across nodes	Scalable quantum power
Clock Synchronization	High-precision timekeeping	System-wide accuracy

Satellite QKD	Secure global comms via satellites	Global reach
Federated Quantum AI	Privacy-preserving model training	Confidential data collaboration
Quantum Sensor Networks	Linked quantum sensors	Scientific and defense utility
Industries	**Description**	
Automotive	Efficiently predict the lifetime of batteries	
Pharma and chemicals	Simulate molecular processes for drug discovery	
Finance	Consider more collaterals and solve with higher accuracy	
Security	Use quantum random number generators to enhance security	
Source: The Quantum Insider		

Cybersecurity is a top priority of the U.S. Department of Energy, especially as it pertains to the country's power grid. In 2018, the U.S. Department of Energy created the Office of Cybersecurity, Energy Security and Emergency Response to research technologies that help prevent, detect and mitigate cyberattacks, with an emphasis on communication and cloud-based operations. At TVA, a team of cybersecurity experts in downtown Chattanooga monitor more than 1 billion potential cyberthreats every day (Flessner, 2020). "*This is probably the most advanced quantum network in the country, especially considering that this is in a real utility environment*," said Nicholas Peters, group leader for the Quantum Science Research Group at ORNL.

6.4 Value Chain

Five elements make up the QT value chain: equipment and components, hardware, systems software, application software, and services.

Funding for QT start-ups in 2024 nearly doubled year over year to $2 billion. Most new start-ups are in equipment and components and application software. However, a value shift away from equipment and components to application software and services is expected over the next five to ten years. McKinsey's *2025 Quantum Technology Monitor* estimates that the market size of the quantum computing space is $28 - $72 billion; growth of 11-14 percent each year is expected over 10 years. By then the business value of quantum computing for the automotive, chemical, financial services, and life sciences industries could total more than $1.3 trillion. By 2035, the quantum communication market including quantum key distribution (QKD), post-quantum cryptography (PQC), and quantum internet infrastructure is projected to reach a value between $10.5 billion and $14.9 billion, growing at a compound annual growth rate (CAGR) of 23-25 percent. The quantum sensing market is the smallest segment, currently believed to be about $7-$10 billion in size.

Who is investing in Quantum?

Table 6.2 Commercial Quantum Interest

Company	Key Areas	Company guidance / forecasts
IBM	• IBM Quantum System Two: A modular and scalable quantum computing platform. • Qiskit SDK: Open-source quantum programming toolkit.	• Quantum Revenue (Cumulative): Over $1 billion as of early 2025. • Expects substantial future growth in quantum, driven by enterprise adoption, cloud

	• Quantum-Centric Supercomputing: Integrating quantum and classical computing. • IBM Quantum Safe: Post-quantum cryptography solutions.	access and hybrid quantum-classical systems.
Google Quantum AI	• Sycamore Processor: Achieved quantum supremacy in 2019. • Quantum Virtual Machine and open-source tools for quantum simulation. • Focus on fault-tolerant quantum computing and quantum machine learning.	• Google's Willow chip breakthrough in 2024 positions it for future commercialization through Google Cloud. • Revenue is more research-driven than commercial at this stage.
Microsoft (Azure Quantum)	• Quantum development kit with Q# language. • Cloud-based quantum computing via Azure Quantum. • Partnerships with hardware providers like IonQ and Quantinuum.	• Focused on quantum-readiness programs and hybrid applications. Microsoft is investing in logical qubit systems and partnerships. • Monetizing through cloud-based quantum services and partnerships.
Intel	• Silicon-based spin qubits. • Cryogenic control chips (Horse Ridge). • Emphasis on scalable quantum hardware.	• NA
Quantinuum	• Trapped-ion quantum computers. • Quantum natural language processing and cybersecurity.	• NA
Rigetti Computing	• Superconducting qubit systems. • Hybrid quantum-classical computing. • Quantum Cloud Services (QCS).	• 2025 Forecast: $16 million (41% growth from 2024). • Outlook: Still in early commercialization stages, with plans to scale revenue significantly by 2026–2027.
D-Wave Systems	• Quantum annealing (different from gate-based quantum computing). • Optimization problems in logistics, finance, and manufacturing. • One of the few with commercial clients using quantum annealing for optimization problems.	• 2025 Forecast: $21.4 million (average analyst estimate). • Outlook: Transitioning from cloud services to hardware sales, with real-world deployments in manufacturing and pharma.
IonQ	• Trapped-ion quantum computers. • Notable for being one of the first quantum computing companies to go public.	• 2025 Forecast: $75–95 million • Outlook: Strong growth driven by government contracts, acquisitions, and hybrid quantum-classical applications.
Source: Startus Insights		

Quantum Hubs

Start-ups are increasingly consolidating into clusters, with emerging hubs in Asia and growing clusters in the U.S. in Colorado, Illinois, Maryland and New Mexico. These hubs are supported by a mix of academic excellence, government funding, private investment, and entrepreneurial ecosystems. As QT matures, growing commercial and public interest will further drive the growth of existing clusters and development of new, emerging clusters.

Table 6.3 Quantum Clusters		
Established Quantum Hubs		
	Institutions	**Focus Areas**
Chicago, Illinois	University of Chicago, Argonne National Laboratory, Fermilab	Quantum networking, quantum computing, and quantum sensing
Boston/Cambridge, Massachusetts	MIT, Harvard University	Quantum algorithms, quantum hardware, and quantum materials
San Francisco Bay Area, California	Stanford University, UC Berkeley, Google Quantum AI, IBM Research	Quantum computing hardware, quantum software platforms
Boulder, Colorado	University of Colorado Boulder, NIST	Quantum sensing, atomic clocks, and quantum standards
Emerging Quantum Clusters		
City	**Institutions**	**Focus Areas**
Pittsburgh, Pennsylvania	Carnegie Mellon University, University of Pittsburgh	Quantum computing applications in healthcare, finance, and robotics
Austin, Texas	University of Texas at Austin	Quantum hardware and software development
New York City, New York	Columbia University, NYU	Quantum finance, quantum cryptography

6.5 The Value

EPB's partnership with IonQ will soon bring IonQ's *Forte Enterprise* Quantum Computer to Chattanooga. The focus will be on finding practical applications for securing and optimizing the power grid, with IonQ supporting the effort through its development expertise while training EPB employees as quantum application developers. EPB will sell access time to the computer to other companies wishing to do their own research and development.

Plans are in the early stages for EPB, IonQ, and other partners to set up a Chattanooga-Oak Ridge-Nashville quantum network triangle, or "*Tennessee tri-tangle*"[30], the first of its kind to facilitate large area networking tests.

Could this be the next emerging quantum hub?

[30] A term coined by Duncan Earl, a former ORNL researcher, and now Senior Director of Quantum Networking at IonQ.

Table 6.4 The Tennessee Tri-Tangle		
Area	**Institutions**	**Focus Areas**
Chattanooga, TN Oak Ridge, TN Nashville, TN	UT Chattanooga; ORNL; EPB Quantum Center; Chattanooga Quantum Collaborative; IonQ, IBM	Hybrid Classical-Quantum networking; Quantum communication; Quantum computing applications in electric grid cybersecurity, healthcare, finance, and robotics;

Media Coverage

The quantum initiative in Chattanooga has already begun to garner high quality media awareness and coverage. As of December 2024, there were 1,169 stories covering the fiber infrastructure in Chattanooga with particular focus on the quantum initiative. The advertising equivalency value of this coverage was previously estimated at **$34.7 million** (see Chapter 3).

A sampling of articles since 2020 is below:

The New York Times - How A.I. Could Reshape the Economic Geography of America

CNET – Say Hello to the Country's Fastest Residential Internet Plan – in Chattanooga, Tennessee

Bloomberg – Chattanooga to Open First Commercial Quantum Network in July

AP News – EPB Quantum Network powered by Qubitekk hosts Oak Ridge National Laboratory's first run on a commercial quantum network

MarketWatch – The next Austin? This booming city in Tennessee is about to take a leap into quantum networking.

American Thinker - Chattanooga Goes Brave New World - American Thinker

Valuation Framework

Hamilton County, anchored by Chattanooga, is emerging as a national leader in quantum networking. With the deployment of the nation's first gigabit speed community-wide broadband network in 2010, Chattanooga gained global recognition as an innovative city, earning the moniker "*Gig city.*" The cache from this venture built on a robust fiber optic backbone has led to the next big innovation by EPB, a first-of-its-kind commercial quantum network in the U.S. in strategic partnerships with Oak Ridge National Laboratory and IonQ (Flessner, 2024).[31] The hybrid classical-quantum infrastructure is positioned to support national security goals and commercial applications in energy and grid security, AI, telecommunications, finance, healthcare, pharmaceuticals and more. Currently, the quantum network stands to boost Chattanooga's own economy by offering universities and companies a sandbox to test and develop new equipment and applications involving quantum technology.

To estimate the likely value of quantum technology in Chattanooga and Hamilton County by 2035, we use a hybrid method of IMPLAN modeling and analytical estimates.

[31] IonQ and Ansys achieved a major quantum computing milestone with quantum computing outperforming classical computing when designing important life-saving medical devices. The quantum optimization method which this achievement was based on was pioneered at the Tennessee-based Oak Ridge National Laboratory (ORNL) and successfully implemented on IonQ quantum computers.

6.5.1 Output Effects

STEP 1. At the outset, we consider two endpoint scenarios regarding the likely evolution of QT as follows:

Scenario 1. Modest Growth	Scenario 2. Aggressive Growth
The EPB quantum network is a testbed for commercial and academic uses; the network generates access fees and revenues. Some start-ups locate here, and some state/federal funding supports the efforts of EPB and its partners. UTC's Quantum Information Science and Engineering graduate program begins to gather momentum. Firms prefer to cluster around national labs and Tier 1 academic institutions.	Chattanooga and the region become a true quantum hub with innovation clusters made up of start-up and mature firms, a well-developed quantum workforce, a well-developed Quantum Information Science and Engineering program at UTC, strong industry and government partnerships, and strong capital inflow to scale-up and commercialize the quantum value chain.

STEP 2. To capture the economic value to quantum industry providers (EPB) and end users (the community), we estimate a 10-year IMPLAN output model based on current levels of state/federal support and EPB revenue forecasts. Note that IMPLAN and other similar software do not currently explicitly factor the effects of quantum technology into their generated estimates.

Model inputs are EPB's projected quantum initiative revenues and capital expenditures in the *Wired Telecommunications* sector. Projections are based on current trends in QT and the particular emphasis of UTC on QCOMM and of the city on hybrid networking. In particular, note that annual revenue growth of about 15 percent is expected in quantum computing, and 25 percent in quantum communication.

Figure 6.1 shows the annual revenue effects from 2026 to 2035. We rely on EPB's revenue forecast through to 2029 based on existing and expected contracts. Thereafter, in Scenario 1, we grow the revenues at the rate of 15 percent per year, and in Scenario 2, we grow the revenues at the rate of 25 percent per year.

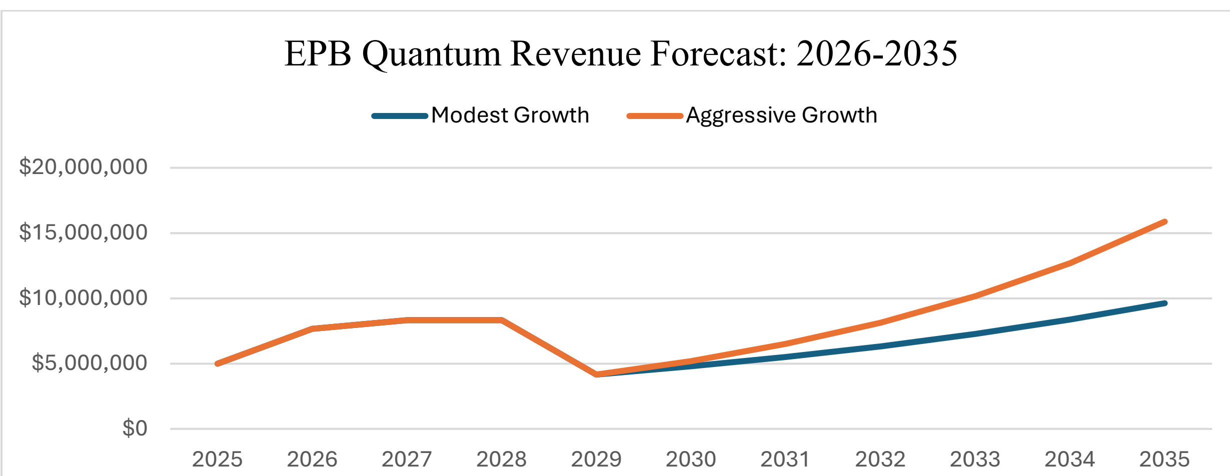
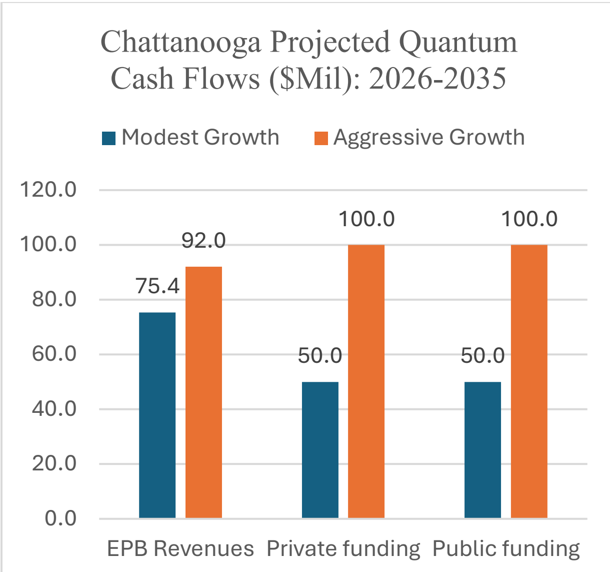


Fig. 6.1 EPB Quantum Revenue Forecast

We assume that private and public funding supporting the quantum efforts in Chattanooga would be $50 million each under the modest growth scenario and $100 million each under the aggressive growth scenario over the ten-year period to 2035.[32] **Figure 6.2** shows the cumulative investments in the quantum industry in Chattanooga through to 2035.[33]



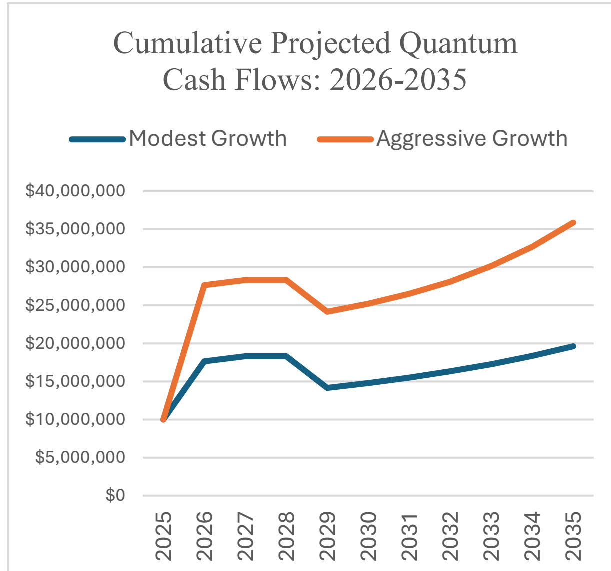


Fig. 6.2 Projected Chattanooga Quantum Cash Flows: 2026-2035

STEP 3. To accommodate the limitations of the IMPLAN model with respect to likely quantum effects and to accommodate the beneficial effects of being an early mover in this space, we scale up the output multiplier by a factor of 1.0x based on current trends in QT.

STEP 4. The output effects estimated are augmented with the expected ad-equivalency of media publicity over the next ten years. The total value of the quantum industry in Chattanooga/Hamilton County is presented in **Table 6.5**.

Table 6.5 Quantum Benefit by 2035

	Scenario 1. Modest Growth	Scenario 2. Aggressive Growth
Model Results		
Direct effects	$360,745,038	$594,096,700
Indirect effects	$227,547,137	$374,738,358
Induced effects	$63,567,676	$104,687,086
Total Output Effect	$651,859,849	$1,073,522,145
Expected Media Publicity#	$35,000,000	$35,000,000
Total Benefit	**$686,859,849**	**$1,108,522,145**

[32] As of October 2025, Quantum companies including IonQ, are in the process of discussing the federal government becoming a shareholder as part of agreements to get funding earmarked for promising technology companies.
[33] UTC's $3 million investment in the Quantum Initiative has been augmented by extramural funding from NIST, NSF and TVA to over $5 million at the time of writing.

Notes: Model estimated with IMPLAN. # Note that the value of expected media exposure is conservatively assumed to be about the same as current exposure over the 2020-2025 period.

The model results suggest a ten-year value of between **$687 million and $1.1 billion** for the Chattanooga region due to the quantum initiative.

6.5.2 Employment Effects

The *Quantum Insider* reports that quantum computing will likely create 840,000 new jobs by 2035, spanning a range of industries, from software development and systems integration to research and development. Industries set to benefit the most from quantum computing include finance, defense, life sciences, telecommunications, and manufacturing.[34] According to the QED-C, North America saw a 4.9 percent increase in new quantum-related job postings over the trailing 12 months as of April 2025.

In 2024, the Boston Consulting Group estimated 191,000 quantum technology jobs in quantum computing, communications, sensing, and supporting industries would be created across Illinois, Wisconsin, and Indiana by 2035 where over $1 billion has already been invested (see **Figure 6.3**). The jobs represent roughly 1.59 percent of the expected 12 million working age population in the region by 2035. The employment estimate was based on rapid scaling of quantum commercialization resulting in 200 percent job growth between 2027-2030 and 550 percent growth from 2030-2035.

Quantum job creation in Illinois-Wisconsin-Indiana
High-end projections, rounded to nearest 1K

Category	Role (degree requirement)	2027	2030	2035
Research & Development	**Scientist** (PhD, master's)	2,000	6,000	26,000
	Engineer (bachelor's)	3,000	10,000	52,000
	Technician (associate's, technical training)	<1,000	3,000	26,000
Business/ translation	**Applied scientist** (PhD, master's)	Few	<1,000	26,000
	Consultant (master's, bachelor's)	Few	<500	3,000
	Support (bachelor's, associate's)	<1,000	3,000	23,000
Adjacent	**Constr./ Manuf.** (associate's, technical training)	2,000	7,000	35,000
TOTAL		**9,000**	**29,000**	**191,000**

Source: Boston Consulting Group for the CQE. Assumes continued government investment.

Fig. 6.3 Projected Quantum Job Creation

[34] The job creation estimates were based on projected QC investments, along with two alternative methods: first, estimating jobs created per dollar invested, and second, estimating jobs created per dollar generated in new revenue. These were triangulated to the trajectory of other sectors such as High-Performance Computing (HPC) and Artificial Intelligence (AI).

By comparison, the Chattanooga area has seen very little investment in this space as of 2025. Using the Chicago Quantum Exchange results as a guide, we model employment in the two scenarios based on growth in the working age population in finance, manufacturing, education, healthcare, information, and utilities as seen below. These focal areas make up roughly 53 percent of Hamilton County employment.[35]

	Assumptions	# of new jobs created
Scenario 1 (Modest Growth)	Focus area workforce grows by 2X the 2011-2025 average	678
Scenario 2 (Aggressive Growth)	Focus area workforce grows by 4X the 2011-2025 average	2,034

We expect that by 2035, the quantum initiative in Chattanooga will have generated between 678 and 2,034 new jobs.[36] These jobs will span the gamut of the quantum industry from quantum hardware and software development to cybersecurity, grid security, education and training, research and development, infrastructure and support services.

[35] See Table 2.3 for more details.
[36] These jobs are in addition to normal workforce growth in the focal industries.

CHAPTER 7. LOOKING FORWARD TO 2035

7.1 The value of fiber optic infrastructure: The next 10 years

Using ICA modeling described in Chapter 3, we project the value of the fiber infrastructure out ten years to 2035 based on previously described benefits from high-speed broadband and the smart grid, in addition to developments surrounding the quantum initiative. The key value components are:

1. Projected output effects from broadband revenues (IMPLAN contribution analysis)
2. Projected smart grid savings (analytically estimated)
3. Projected economic effects of the quantum initiative (analytically estimated)

Fiber revenues are projected by EPB to grow by 0.69% annually based on the growth in residential and commercial customers. The revenue stream is depicted in **Fig. 7.1**.

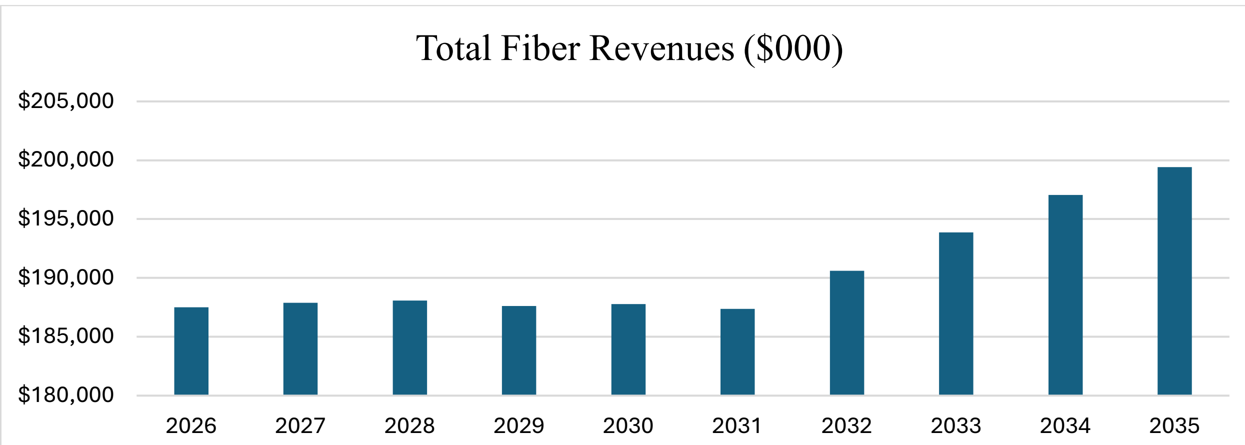


Fig. 7.1 Projected Fiber Division Revenues: 2026-2035

Smart grid savings have annually averaged $99.5 million over the period 2014-2025. We project savings at the same annual levels through 2035.

Significant developments surrounding the evolution of quantum technology (see Chapter 6) are also likely to sharply impact the estimates for 2035.

The total expected jobs (new and saved) are based on 1) growth in the working age population at the annual average for the 2011-2024 period (0.51%) and 2) application of the high-speed broadband effect from Lobo *et al*. (2020).

Table 7.1 summarizes the expected benefits of the fiber infrastructure through 2035.

Table 7.1 Summary of Expected Benefits of Fiber Infrastructure: 2011-2035

	2026-2035	**2011-2035**
High-speed Broadband ($Million)	$3,044	$6,772
Smart Grid ($Million)	$995	$2,089
Quantum Initiative ($Million)	$687 – $1,109	$687 – $1,109

Total Value ($Million)	$4,726 - $5,148	$9,548 - $9,970
Total Jobs	7,708 – 9,070	20,231 – 21,593

We estimate that the fiber infrastructure which supports high-speed classical broadband, the smart grid, and quantum technology is likely to generate between $4.7 billion and $5.1 billion in economic value for the Chattanooga region over the next ten years. In addition, we expect the infrastructure will be responsible for between 7,700 and 9,000 jobs in the region in that period.

7.2 Conclusion

A couple of earlier studies have attempted to document the realized value of fiber infrastructure in Hamilton County and Chattanooga (Lobo, 2015; Lobo, 2020). Those studies used analytical methods to capture the economic benefits in the community. In this study, we have used both analytical and model-based (IMPLAN) methods to measure value. We find that previous studies (i.e. Lobo, 2020) might have underestimated the value of the infrastructure by as much as 17 percent.

Critics of EPB's venture into fiber optics point to the need for taxpayer subsidies or cross-subsidies from other municipal entities to make investment and business development possible, effectively leading to predatory entry and the stifling of competition (Beard et al., 2021). We find the opposite to be true. The fiber division has helped "*reverse subsidize*" the electric ratepayers in generating significant value as seen in Chapter 3. The cost savings and cash generated by the fiber optics division has enabled the utility to build-up cash reserves to deal with contingencies, plant replacement and maintenance, and to defer electric rate hikes and avoid costly capital market transactions. Moreover, the infrastructure has served to lower broadband prices and push competitors to improve service offerings in the area.

Along with the smart grid, fiber broadband has generated over $5.3 billion in economic value and over 10,400 jobs from 2011-2025 at an incremental value-to-cost ratio of 6.4x as seen in **Fig. 7.2**.[37]

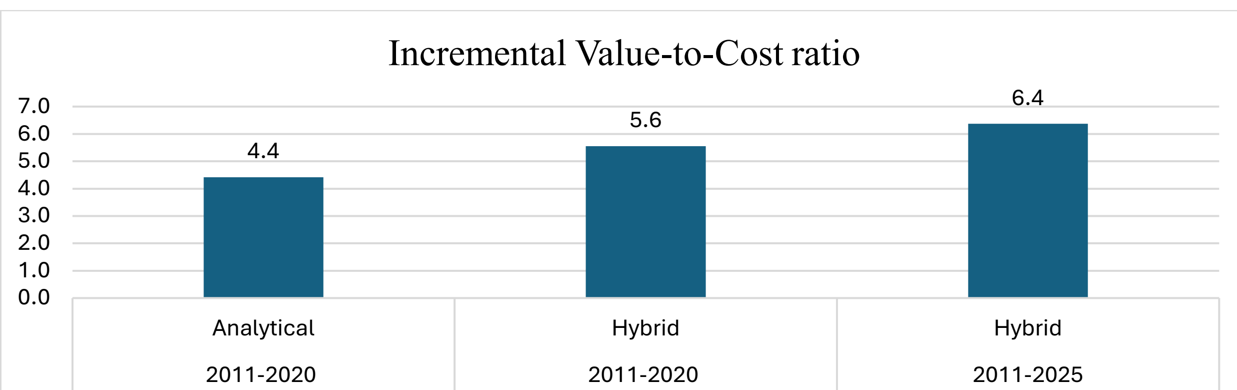


Fig. 7.2 Incremental Value-to-Cost of the Fiber Optic Infrastructure

[37] Our initial cost of infrastructure is $396.1 million (Lobo, 2020). To compare benefits to costs in 2025, we bring forward this cost using the average annual yield on the ten-year Treasury security. We add to this estimate further capital investments made in the fiber infrastructure from 2020 through 2025 totaling $154.6 million.

Fiber networks are poised to be the backbone for a host of revolutionary technologies and services in the coming decade, enabling transformative technologies and services such as:

- Quantum Networking: Quantum Key Distribution (QKD) and entanglement delivery which enables unbreakable encryption.
- 6G & Beyond: Ultra-high-speed, low-latency connectivity which supports immersive AR/VR, autonomous mobility.
- AI Infrastructure: High-speed interconnects for distributed AI, vital for training and inference at scale.
- Edge Computing: Dense connectivity for IoT and smart cities which supports localized data processing.
- Telepresence & XR: Immersive holographic communication, which could revolutionize collaboration, education, and entertainment.
- Space-Ground Integration: Fiber links to quantum/optical satellite stations with connects to terrestrial and space-based systems.
- Autonomous Systems: Real-time control and updates, critical for vehicles, drones, and robotics.
- Decentralized Finance: Ultra-fast blockchain and financial data transfer which ensures secure, scalable digital transactions.

Chattanooga appears ready to meet these new developments. By 2035, it is likely that the moniker "*Quantum City*" will apply.

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