



# Research & Policy INsights

---

Estimation of the Net  
Benefits of Indiana  
Statewide Adoption  
of Rural Broadband

**Alison Grant**  
Purdue University

**Wallace E. Tyner**  
Purdue University

**Larry DeBoer**  
Purdue University

August 2018

Publication 006

**PURDUE**  
UNIVERSITY



**Center for Regional Development**  
Advancing Collaboration : Energizing Regions

ALISON GRANT



Alison Grant is currently pursuing her Ph.D. degree in the department of Agricultural Economics at Purdue University. She possesses a Master of Science degree in Food, Agricultural and Resource Economics from the University of Guelph in Ontario, Canada. Trained as an agricultural and resource economist, Alison Grant's research has focused on the economic impact of perceived environmental externalities using econometric analysis. Specific research themes include modeling the impact of aggregate sites on surrounding rural residential property values; examination of the factors that affect farmland values and rental rates; determining the economic costs of pesticide policy in Ontario; and exploration into the application of water markets.

WALLACE E. TYNER



Professor Tyner's recent research interests are in the area of climate, energy, agricultural and natural resource policy analysis. His work in energy economics has encompassed oil, natural gas, coal, oil shale, biomass, biofuels from agricultural sources and solar and wind energy. Much of his recent work has focused on economic and policy analysis for biofuels and the interplay between biofuels policies and other energy policies. He has over 330 professional papers including three books and 115+ journal papers, published abstracts and book chapters. His work has been cited over 5,700 times according to Google Scholar with an h index of 34 and i10 index of 97. His current research focuses on renewable energy policy issues and the links among energy, agriculture and climate change. He was Co-chair of the National Academy of Science Committee on the Economic and Environmental Impacts of Biofuels (2011). In 2016, he chaired a National Academy panel on advanced biofuels. He teaches a graduate course in benefit-cost analysis, which incorporates risk into the economic and financial analysis of investment projects.

LARRY DEBOER



Larry DeBoer is a professor and extension specialist in Agricultural Economics at Purdue University. He studies state and local government public policy, including such topics as government budget and taxing options, issues of property tax assessment, local government revenue options and the fiscal impact of economic development. Larry DeBoer earned his undergraduate degree at Earlham College in Richmond, Indiana in 1978, and his Ph.D. at Syracuse University in Syracuse, New York, in 1983. He taught economics at Ball State University in Muncie, Indiana, from 1982 to 1984, before joining Purdue's staff in September 1984.

## ■ Executive Summary

This paper projects the statewide net benefits that could be obtained from installation of rural broadband in all of the areas served by Rural Electric Member Cooperatives (REMC) in the state of Indiana. This analysis draws heavily upon an initial analysis that was done for the Tipmont Cooperative. Then six additional Indiana REMCs were added, although with somewhat less precision than the original Tipmont analysis. Then the benefit-cost results of these seven REMCs were extrapolated to the state of Indiana. Table ES-1 provides a summary of the benefit-cost metrics from the analysis. The benefit-cost ratios range from 2.97 to 4.09 for the seven REMCs. From a societal perspective, the rural broadband investment is clearly quite attractive. However, the anticipated revenue from customers would not be adequate to cover the total system costs, so some form of external assistance would be needed to incentivize the investments.

**Table ES-1. Metrics for Broadband Investment by Cooperative**

Cooperative	NPV	Ann. NPV	B/C	Members	NPV/member	B/member cost	Rev/cost
Tipmont	560,280,195	48,847,781	3.96	22,631	24,757	4.49	0.54
Henry County	190,129,578	16,576,363	3.24	8,500	22,368	3.96	0.45
Jackson County	582,505,581	50,785,491	4.09	24,203	24,067	4.33	0.58
Marshall County	165,610,509	14,438,679	3.03	7,249	22,846	4.06	0.40
Noble County	246,440,421	21,485,799	3.47	10,646	23,149	4.13	0.48
Orange County	166,377,353	14,505,536	2.97	7,756	21,451	3.75	0.41
Whitewater	341,256,815	29,752,324	3.84	11,741	29,065	5.44	0.44

The sum of net present value of benefits for the seven cooperatives is \$2,252,600,453. There are 92,726 members in these co-ops, so the net benefit per member is \$24,293 (weighted average) for the seven cooperatives. Extrapolating the net benefits for these seven REMCs to the state, the total for the state of Indiana would be \$11,976,222,899. In other words, the state of Indiana would receive about \$12 billion in net benefits if the broadband investment were made statewide. That translates to \$1 billion per year annuitized over 20 years at six percent interest rate.

In addition to the benefit-cost analysis, this report quantifies the additional state and federal tax collections and cost savings that could happen with broadband investments in these seven REMCs. Table ES-2 summarizes the added federal and state tax collection and medical cost reductions that could result from the rural broadband investments. These tax/cost enhancements amount to \$56.5 million in year three for the seven REMCs, or 27 percent of the total net benefits of \$208 million. The shares should be similar for the duration of the broadband investment period.

**Table ES-2.** Summary of federal and state tax benefits as compared with total net benefits in year three

Cooperative	Year 3 Net Benefit	Total Federal	Total State of Indiana	Total, Federal and State
Henry	17,602,347	4,509,702	825,662	5,335,364
Jackson	53,840,546	11,347,964	2,082,798	13,430,762
Marshall	15,347,027	3,522,749	685,967	4,208,716
Noble	22,936,160	5,170,303	940,571	6,110,874
Orange	15,416,517	4,019,580	757,246	4,776,826
Tipmont	51,638,797	10,610,488	1,940,658	12,551,146
Whitewater	31,253,692	8,761,850	1,358,954	10,120,804
<b>Total REMC</b>	<b>208,035,086</b>	<b>47,942,638</b>	<b>8,591,854</b>	<b>56,534,492</b>

These estimates are for the seven REMCs. We estimate the net benefits of broadband investment for the whole state of Indiana is about \$12 billion, which is about \$1 billion per year annuitized over 20 years at six percent interest rate. Year after year, added government revenues and cost savings would amount to about 27 percent of net benefits in the seven REMCs each year. If the rest of rural Indiana is like these seven Cooperative service areas, then 27 percent of the \$1 billion per year would be government revenue and health care cost savings, or \$270 million per year. In terms of total net present value of benefits, 27 percent of \$12 billion is \$3.24 billion in added government revenue and health care cost savings.

---

This study was commissioned by Tipmont REMC and Indiana Electric Cooperatives and funded by CoBank.

---



## Introduction

The purpose of this paper is to project the statewide net benefits that could be obtained from installation of rural broadband in all of the areas served by Rural Electric Member Cooperatives (REMC) in the state of Indiana. Initially, we performed a detailed analysis of the potential for rural broadband in the area served by Tipmont REMC [1]. In this study we use the same approach used for Tipmont for six additional cooperatives, and then use the results from the total of seven cooperatives to extrapolate to the state. This analysis on the six additional cooperatives follows the same methodology used in the separate report on Benefits and Costs of Rural Broadband for the Tipmont REMC service area [1].

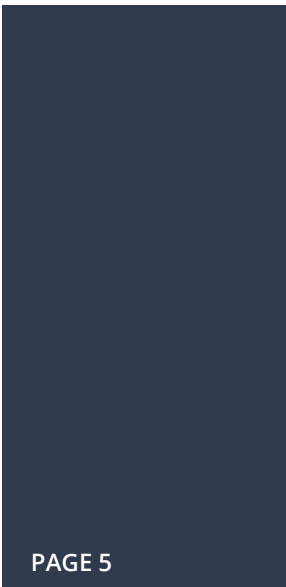
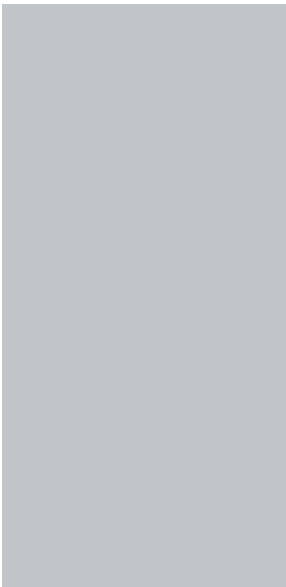
The main report provides an overview of the approach used for the analysis, presents the summary results for the six additional REMCs analyzed in greater detail, and the extrapolation from the results of these analyses to all the REMCs in the state. There is also an appendix with more detailed results for the six additional cooperatives. The final section of the report examines benefits to federal and state governments—the federal and state of Indiana tax revenues and health program cost savings.

## Approach to Estimation for the Six Additional REMCs

The detailed analysis that was performed for the Tipmont REMC was replicated in a somewhat abbreviated sense for Henry, Jackson, Marshall, Noble, Orange, and Whitewater Cooperatives. Detailed data on items such as distances to hospitals, median household income, teacher expenditures in the relevant school districts, farm sales, etc. were collected for these cooperatives. While the analysis is not as detailed as that for Tipmont, the same procedures were followed.

## Benefit categories

It is clear from the literature that rural broadband is expected to provide benefits in a variety of areas. Some of the most important are telemedicine, education, business investment and general economic development, farm income, civic engagement, and property values. While benefits are not limited to these areas, these are the areas that have received the most attention in prior studies and the areas with greatest potential for benefits. What this means, of course, is that the estimates we produce are a conservative assessment of total benefits because we are not able to capture all possible benefits. In the rest of this section, we offer a brief summary of the approach we are using in each of these areas. Section III provides the actual benefit estimations for each category.



## *Telemedicine*

For telemedicine, we follow the categorical benefit approach used by Whitacre [2]. When telemedicine is used effectively, benefits can accrue through reducing the physician time required for treatment and diagnosis, transportation savings for patients, missed work income savings, initial health consultation via web, health improvement, improved health knowledge and improved self-care, and reduced use of emergency room and other expensive hospital facilities.

## *Education*

There are numerous possibilities for benefits in education. We estimated benefits for K-12 education and adult education. Today, K-12 students can complete and turn-in their homework exercises via the web. They can also communicate with their teachers electronically. Not only today, but even more so in the future, access to broadband will significantly improve student performance. If rural students do not have access to broadband, they will increasingly be disadvantaged by the digital divide.

Massive Online Courses (MOCs) are only possible with broadband access.<sup>1</sup> They are becoming increasingly important in continuing education as well as a means of students participating in their regular classes via the web instead of the traditional classroom [3]. The expectation is that MOCs will continue to grow and that rural access will be essential for rural citizens to have a level playing field with their urban counterparts. Computer classes are generally less expensive and more cost effective than traditional classroom based learning, so with rural broadband, citizens will have access to lower cost but effective education and job skill upgrade options. Distance education will become an important vehicle for rural residents to improve job skills and even obtain higher paying jobs.

## *Business investment and general economic development*

Numerous studies have concluded that broadband access is an important factor contributing to business investment and job creation as well as general economic growth in rural areas. Whitacre et al. find that broadband adoption has a positive impact on economic growth and a negative impact on unemployment in rural areas [4]. They also note that rural broadband adoption leads to improved median household incomes and an increased share of non-farm rural businesses [5]. Kim and Orazem state that broadband access has a positive impact on firm location decisions in rural areas [6]. Kolko also found a positive impact of broadband on local economic growth [7]. Sosa concluded that gigabit broadband contributes even more to GDP growth in communities where it is adopted [8]. Lobo et al. provided multiplier impacts of broadband investments [9]. We use these and other sources to estimate the potential contribution of rural broadband access to rural economic growth and development.

Entrepreneurship and startup activities also are influenced by local infrastructure. Audretsch et al. surmise that broadband access is more important than traditional infrastructure such as railroads and highways [10] in startup activity.

---

<sup>1</sup> These courses are also called Massive Online Open Courses (MOOCs)

In addition to these benefits, the very fact of investing in rural broadband creates spillover incomes and jobs in rural areas. These benefits are called multiplier benefits.

### *Consumer savings through broadband*

The Ohio report cites one study which claimed consumers saved \$9,000 per year in various types of consumer purchases [11] by using broadband. That estimate comes from an advocacy group and likely overstates the consumer savings. However, a study conducted in the United Kingdom by Price Waterhouse Coopers estimates consumers save £560 (\$754) per year in insurance, energy, general shopping and for services online [12]. We will apply that value to the annual connected households in each cooperative. We consider this to be a more reasonable estimate. We will assume that this value remains constant in real terms over the life of the project, although it is likely to grow. The Hudson Institute report also argues that online shopping savings of all kinds represent a large benefit area. For the U.S. rural broadband penetration already achieved, they put the annual benefit at \$1 billion.

### *Farm income changes*

One can imagine a myriad of ways in which rural broadband access would lead to increased farm profitability – easier communications with suppliers and market outlets, access to Extension and other farm practice information, quicker access to weather information that could impact management decisions and generally improved farm management practices. Kandilov et al. conclude that increased rural broadband access could lead to a six percent increase in farm revenue [13].

## **Investment and operating costs**

For Tipmont, we had detailed engineering cost information for both capital and operating cost from a feasibility study. Since that information was not available for the other co-ops, we developed some assumptions in collaboration with Tipmont on cost estimation for the other cooperatives. Table 1 illustrates the assumptions used for capital cost. The first column provides the capital cost component assuming a 100 percent take rate. The second column provides the actual values for Tipmont adjusted for the assumed customer fraction taking the service as a fraction of current membership. Since membership is assumed to grow a bit over time, the fraction used here (61.1 percent) is slightly higher than the assumed take rate of 58 percent. In the Tipmont column, the first two rows do not change as they were calculated directly for the Tipmont system. The other three rows are multiplied by 61.1 percent to get the actual value for Tipmont.

For the other co-ops, these capital costs had to be recalibrated to the conditions for each co-op. In this text, we will illustrate the calculation for the Henry County REMC, and the data for the other REMCs is in the Appendix. Henry is a much smaller co-op than Tipmont, and costs are driven by number of customers and line miles. The first row, distribution fiber was adjusted based on the miles of line relative to Tipmont. Thus, the Tipmont value was divided by the miles of line for Tipmont (2,655) to get a per mile cost, and that value then was multiplied by the miles for each co-op. For Henry county, that value was 1,031 resulting in a distribution fiber cost of



\$33,427,038. The second row, core fiber, was assumed to be a fixed cost that would exist for any co-op regardless of size. The last three rows are a function of number of customers. Thus, we multiplied those values for Tipmont by the ratio of mature number of customers (year 10 onwards) for each new co-op divided by the Tipmont number. For Henry county, that value is 5,195/13,831 = 0.376. The identical process was followed for the other co-ops. Capital costs were lower than Tipmont for all the other co-ops except Jackson county. The cost estimates for the six additional REMCs use reasonable assumptions, but are not as accurate as those for Tipmont.

**Table 1.** Capital costs estimates for Tipmont extrapolated to Henry county

	Cost	Tipmont	Henry
Capital Cost	Basis*	Amount	Amount
Distribution Fiber	86,080,296	86,080,296	33,427,038
Core Network	1,625,000	1,625,000	1,625,000
Substation Electronics*	4,561,405	2,787,674	1,047,066
Drop Installation*	12,359,200	7,553,248	2,837,042
Subscriber Electronics*	12,675,600	7,746,614	2,909,671
Total Build Capital Cost	117,301,501	105,792,832	41,845,816

\*Based on 100 percent take rate

Similarly, operating costs had to be adjusted as well. All the operating cost components that were a function of customers used the same approach (but not the same values) as Tipmont. The two operating costs that had to be adjusted were fixed operating cost and labor costs. We made the same assumption for both these categories. The assumption is that half the costs were fixed and would not vary with co-op size. The other half were assumed to vary with the ratio of mature customers as was done for the last three categories of capital costs. Thus, half the original fixed and labor costs were assumed not to vary across co-ops, and half were a function of the customer base relative to Tipmont.

**Benefit-Cost Summary for Each Cooperative**

Table 2 presents the net present values by category for the six additional cooperatives evaluated in this extended analysis.





Table 2. Net present values for Henry, Jackson, Marshall, Noble, Orange, and Whitewater Cooperatives

Item	Henry County	Jackson County	Marshall County	Noble County	Orange County	Whitewater
<i>Capital cost</i>	39,477,185	94,291,674	39,695,678	47,303,715	41,209,844	64,492,992
<i>Operating cost</i>	45,585,299	94,512,936	41,695,659	52,270,652	43,395,035	55,682,464
<b>Total cost</b>	<b>85,062,484</b>	<b>188,804,610</b>	<b>81,391,338</b>	<b>99,574,368</b>	<b>84,604,880</b>	<b>120,175,457</b>
<b>Telemedicine</b>						
<i>Primary care savings</i>	8,630,252	24,574,204	7,359,961	10,808,979	7,874,830	11,920,916
<i>Specialist</i>	6,161,642	29,902,085	3,624,495	14,316,756	4,168,169	73,033,576
<i>Transport</i>	229,719	1,484,335	158,718	364,459	227,816	384,630
<i>Missed Work</i>	1,770,587	7,283,885	1,602,454	2,638,652	1,635,165	2,588,671
<i>Pharmacy</i>	7,884,427	22,450,508	6,723,915	9,874,870	7,194,289	10,890,713
<i>Imaging</i>	1,598,195	4,550,779	1,362,956	2,001,663	1,458,302	2,207,577
<i>Web consultation</i>	1,917,834	5,460,934	1,635,547	2,401,995	1,749,962	2,649,092
<i>Urgent care</i>	8,150,793	23,208,971	6,951,074	10,208,480	7,437,340	11,258,643
<i>Emergency care</i>	41,685,447	118,697,200	35,549,747	52,209,036	38,036,644	57,579,862
<b>Total telemedicine</b>	<b>78,028,894</b>	<b>237,612,900</b>	<b>64,968,868</b>	<b>104,824,889</b>	<b>69,782,517</b>	<b>172,513,680</b>
K-12 education	6,059,921	39,314,370	6,035,729	7,041,388	3,724,420	12,223,505
Adult education	23,711,350	71,500,316	22,590,991	32,761,881	21,289,263	32,580,893
Multiplier impacts	84,211,859	186,916,564	80,577,424	98,578,624	83,758,831	118,973,702
Consumer savings	40,167,961	114,376,235	34,255,621	50,308,457	36,651,987	55,483,768
Farm income increase	4,655,404	12,371,120	5,862,275	4,459,644	775,971	16,674,876
System revenue	38,356,673	109,218,686	32,710,938	48,039,906	34,999,245	52,981,847
<b>Total benefit</b>	<b>275,192,062</b>	<b>771,310,191</b>	<b>247,001,846</b>	<b>346,014,789</b>	<b>250,982,233</b>	<b>461,432,271</b>
<b>Net benefits</b>	<b>190,129,578</b>	<b>582,505,581</b>	<b>165,610,509</b>	<b>246,440,421</b>	<b>166,377,353</b>	<b>341,256,815</b>

## Summary measures of Investment worth

Table 3 presents a summary of the other metrics for broadband investment by cooperative. As can be seen from the table, the metrics vary quite a bit from one cooperative to another. The differences emerge from differences in costs and benefit estimates by category.

**Table 3.** Metrics for Broadband Investment by Cooperative

Cooperative	NPV	Ann. NPV	B/C	Members	NPV/member	B/member cost	Rev/cost
Tipmont	560,280,195	48,847,781	3.96	22,631	24,757	4.49	0.54
Henry County	190,129,578	16,576,363	3.24	8,500	22,368	3.96	0.45
Jackson County	582,505,581	50,785,491	4.09	24,203	24,067	4.33	0.58
Marshall County	165,610,509	14,438,679	3.03	7,249	22,846	4.06	0.40
Noble County	246,440,421	21,485,799	3.47	10,646	23,149	4.13	0.48
Orange County	166,377,353	14,505,536	2.97	7,756	21,451	3.75	0.41
Whitewater	341,256,815	29,752,324	3.84	11,741	29,065	5.44	0.44

## Extrapolation to the State of Indiana

The sum of net present value of benefits for the seven cooperatives is \$2,252,600,453. There are 92,726 members in these co-ops, so the net benefit per member is \$24,293 (weighted average) for the seven cooperatives. There are 400,263 Cooperative members in Indiana not included in the seven listed here. So the extrapolated net benefits for those cooperatives would be \$9,723,622,446. Adding back the net benefits for the seven cooperatives included in this analysis, the total for the state of Indiana would be \$11,976,222,899. In other words, the state of Indiana would receive about \$12 billion in net benefits if the broadband investment were made statewide. That translates to \$1 billion per year annuitized over 20 years at six percent interest rate.

## ***Federal and State of Indiana Revenues and Cost Savings***

Our study estimates the income growth and telemedicine cost savings from the expansion of broadband access to REMC customers in Indiana. Most of the added income and cost savings benefit the people in REMC households, but some benefits will accrue to the federal government and to the government of the state of Indiana.

Rural broadband adoption will increase incomes. Some of this added income will be paid in federal income taxes, and some in state income taxes. Federal and state income tax revenues will increase. Added income will increase spending, some on products that are subject to Indiana's sales tax. Indiana sales tax revenue will increase.

Telemedicine cost savings will also partly accrue to the federal and state governments. Health care costs are shared by household as out-of-pocket payments, private insurance companies as benefit payments, and the federal Medicare and federal and state Medicaid program as benefit payments. Telemedicine cost savings will reduce Medicare and Medicaid payments, lowering federal and state expenditures. Income growth will reduce the number of people who are eligible for Medicaid, further shrinking federal and state costs. In addition, most health care spending is not subject to the Indiana sales tax. Part of the out-of-pocket savings on health care will be spent on sales taxable products. Indiana sales tax revenue will rise further.

These added revenues and cost savings to the federal and state governments could be a significant share of the total rural broadband benefits. About three-quarters of adjusted gross income of the households in the seven REMCs are in federal income tax brackets with rates of 22 percent or more. Indiana's flat rate tax is 3.23 percent. Almost half of typical household consumer spending is taxable under Indiana's sales tax, at its seven percent rate. It is apparent that these three taxes combined could collect at least 30 percent of added incomes from expanded broadband access. Federal Medicare and federal and state Medicaid pay 40 percent of the nation's health care costs. That percentage of telemedicine cost savings could represent reduced expenditures for the federal and state government. Combined, between 30 percent and 40 percent of added income and cost savings from rural broadband adoption could accrue to these governments.

The economic analysis projects added income from adult education and the multiplier, plus telemedicine savings, of about \$148 million in year three. Using methods that take account of the distribution of incomes within the seven REMCs, we estimate that federal and state of Indiana added revenues and cost savings from rural broadband adoption total \$57 million in year three, with similar figures in each subsequent year. This is 38 percent of added adult education and multiplier income plus telemedicine savings, and 27 percent of total estimated net benefits. Of the total, \$48 million benefits the federal government, and \$9 million benefits the state of Indiana's government.

These estimates are for the seven REMCs. We estimate the net benefits of broadband investment for the whole state of Indiana is about \$12 billion, which is about \$1 billion per year annuitized over 20 years at six percent interest rate. Year after year, added government revenues and cost savings would amount to about 27 percent of net benefits in the seven REMCs each year. If the rest of rural Indiana is like these seven cooperative service areas, then 27 percent of the \$1 billion per year would be government revenue and health care cost savings, or \$270 million per year. In terms of total net present value of benefits, 27 percent of \$12 billion is \$3.24 billion in added government revenue and health care cost savings.

## Estimated Distribution of Income

Estimates for federal income tax revenues and Indiana state sales tax revenues require estimates of not just the incomes of the seven REMCs, but the distributions of income among REMC households. This is because federal marginal income tax rates are higher for higher income households, and also because lower income households pay a greater share of their incomes to the Indiana sales tax.

The federal Internal Revenue Service (IRS) makes adjusted gross income data available by income level, for Indiana counties and zip codes [14, 15]. Survey information provides the number of REMC households in each county, and for two REMCs, in each zip code. The IRS income data are weighted by these household numbers to construct estimated distributions of adjusted gross income for each REMC.

Survey information also provides average incomes for REMC households. For six of the seven REMCs, these averages are within six percent of the average estimated Adjusted Gross Income (AGI) from the IRS data. Small adjustments in the number of households in the top and bottom income categories created income distributions with averages that matched the survey average incomes. The IRS data show the Tipmont REMC with the highest average household income among the seven, but the survey shows an even higher average income. A larger adjustment to the income distribution is required for this REMC. On the whole, however, estimated REMC adjusted gross incomes from IRS data are a good match for survey average REMC income used in the study.

This study estimates added benefits from many sources, but the tax analysis is limited to income from adult education and the multiplier. Added income from adult education represents individuals moving to higher paying jobs. Bigger paychecks imply bigger tax bills. The added incomes and jobs created by the multiplier must also add taxable income. While other broadband effects may generate added taxable income, limiting the tax analysis to these two sources keeps the estimates conservative.

The estimates assume that incomes increase proportionally in each income distribution category. Rural broadband adoption increases incomes by 1.4 percent across all seven REMCs. This percentage increase in each REMC is applied to all income categories in that REMC, so that incomes increase proportionally across all categories.

## Federal Income Tax

Adult education and the multiplier may increase the incomes of existing households. In this case, most deductions and exemptions will not be affected, and the full added income will be taxed at the marginal rate in each taxpayer's tax bracket. The new tax rates from the Tax Cuts and Jobs Act passed in December 2017 are associated with the income categories, then multiplied by the added income in each income category in each REMC. Total added federal income tax revenue is \$15.6 million in year three.

Added income may represent in-migration of households. Deductions and exemptions would increase with added households. Added income would be taxed at the average rate for each income category. Income tax payments by income category are divided by AGI from the IRS data to derive average rates, which are multiplied by the added income in each income category in each REMC. These data are from 2014, before the December 2017 tax change. An analysis by the U.S. Congress' Joint Committee on Taxation [16] provided the average tax change by income category. Rates were adjusted for these changes. Total added federal income tax revenue is \$6.4 million in year three.

The average of the two figures for each REMC are shown in Annex Table C. These results are for year three. A similar amount of revenue would be generated in each subsequent year.

## Indiana State Income Tax

Indiana's state income tax starts with federal AGI, but then makes substantial adjustments. IRS data is used to approximate Indiana taxable income, which is reported by the Indiana Legislative Services Agency [17]. The estimate for total Indiana taxable income was within one percent of the actual taxable income. Indiana taxable income was calculated for each income category in each REMC.

Indiana has a flat rate income tax of 3.23 percent, which is equivalent to the marginal rate. Fixed deductions and exemptions mean that the average tax rate is slightly less than this rate. As with the federal income tax, the state income tax is calculated using both the marginal and average rates. Added income tax revenue for all REMCs is \$2.1 million using marginal rates and \$1.9 million using average rates for year three. Annex Table C reports the average for each REMC, and the total of \$2 million in year three. Added revenue will be similar in subsequent years.

## Indiana State Sales Tax

Households will spend some of their added income, and some of that spending will be on products that are taxed by the Indiana sales tax. The Bureau of Labor Statistics Consumer Expenditure Survey (CES) [18] provides national estimates of household spending by product category. Information from various Indiana sources about what products are taxable were applied to spending in CES product categories, to estimate what share of overall spending is on sales taxable products.

The CES provides cross-tabulations by age and income category, which allowed sales taxable spending to be calculated for 41 age and income combinations. A regression equation related sales taxable spending to income, age and household size. This equation was applied to the average income in each income category, using average household sizes from IRS data, and estimated average age by REMC from Bureau of Census data [19]. The resulting sales taxable spending was multiplied by seven percent, Indiana's sales tax rate. Annex Table C reports the results by REMC. Sales taxes out of added income totaled \$2.4 million in year three. Later years would see similar added revenues.

## Telemedicine Cost Savings

Expanded access to broadband will allow households to reduce health care costs through the use of telemedicine. Most health care costs are paid out-of-pocket by households, by federal Medicare, by federal and state Medicaid and by private insurance companies. National data are available for health care costs. However, on average REMC households are older than households nationally, which means more are eligible for Medicare. REMC households have lower incomes than the nation as a whole, which means more are eligible for Medicaid. National shares might not be representative of the cost shares for households in the seven REMCs, so shares for each REMC are estimated.

Medicaid recipients by county are available from the Indiana Family and Social Services Administration [20]. REMC Medicaid recipients are estimated as the average of county recipient numbers, weighted by the number of REMC households in each county. The average Medicaid cost per recipient is calculated as the total state and federal Medicaid budget [17] divided by total recipients statewide. Each REMC's Medicaid costs are estimated as the product of the number of recipients and the average cost per recipient.

Medicare costs are estimated similarly, using Indiana data from the Federal Centers for Medicare and Medicaid Services [21].

The number of people served by private insurers, or who are uninsured, is calculated as the population in each REMC less Medicaid and Medicare recipients. The average cost per recipient for private insurance is available from the Federal Centers for Medicare and Medicaid Services (CMS). The number of people served by private insurers, times the cost per recipient, is the estimated spending by private insurers. The figures are adjusted downward for the share of Indiana residents who are uninsured.

Out-of-pocket spending per person is based on the Consumer Expenditure Survey (CES) age and income cross tabulations [18]. Spending is regressed on age and income for the 41 CES observations. The REMC household income estimates are then used with this equation to estimate out-of-pocket spending.

The cost shares are derived from these results. For the REMCs as a whole, the estimates show 21 percent of costs borne by Medicaid, 26 percent by Medicare, 39 percent by private insurers, and 14 percent by households as out-of-pocket expenses.

Telemedicine cost savings include all telemedicine benefits, except transport and missed work. Shares of costs for each REMC are multiplied by cost savings in each REMC. Indiana Medicaid cost savings are calculated as 20 percent of the totals, based on the share of costs paid by state general appropriations [17]. The remaining 80 percent are federal Medicaid cost savings. The results are reported in Annex Table C. Total Medicare savings for all REMCs are \$21.4 million in year three. Total federal Medicaid savings are \$13.8 million, and total Indiana Medicaid savings are \$3.4 million. Subsequent years would see similar cost savings.

## Indiana Sales Tax on Out-of-Pocket Savings

A share of out-of-pocket savings, calculated using the method described above, will be spent on other goods and services. Of all health care spending, only non-prescription drugs are subject to the Indiana sales tax. Non-prescription drugs are estimated as four percent of total out-of-pocket costs, and this share is netted out of cost savings. Households will spend or save their health care cost savings, and some of the spending will be on sales taxable goods. The out-of-pocket costs savings are treated as added income, and the added sales tax is calculated as are other added Indiana sales tax revenue, described above. Annex Table C reports results. The total for all REMCs is \$0.36 million in year three, with added revenues continuing in future years.

## Fewer Medicaid Recipients

Incomes are higher as a result of rural broadband adoption. As a result, some households will see their incomes rise above the Medicaid income limits and lose their Medicaid eligibility. This will create added cost savings for the federal and state Medicaid programs.

Indiana Family and Social Services Administration (FSSA) data show the number of Medicaid recipients in each county [20]. The number of recipients per 1,000 population is regressed on county per capita income and population density, as a measure of urbanization. The results show that there are fewer Medicaid recipients per 1,000 population in counties with higher incomes. The coefficient is applied to the increase in per capita income implied by expanded broadband access. The results show a decline in the number of Medicaid recipients of 2.2 percent in the seven REMCs, totaling 274 people. This figure is multiplied by the average Medicaid spending per person, and the telemedicine cost savings for these recipients are netted out, to eliminate double-counting. Annex Table C shows the results. In total, the reduction in the number of Medicaid recipients reduces federal costs by \$1.7 million and Indiana costs by \$0.42 million in year three. Similar savings would continue in subsequent years.



## ANNEX: SUMMARY TABLES FOR OTHER COOPERATIVES

Table B1.1: Benefit Cost Summary over 20 years (current \$USD) in Henry County REMC

Henry County REMC

Year	Total Cost	Total telemedicine	Education K-12	Adult	Multiplier	Consumer Savings	Farm Income	Revenue	Total Benefit	Net Benefit
1	43,841,410	2,199,883	140,199	548,573	43,402,996	929,305	107,705	887,400	48,216,062	4,374,652
2	3,199,373	4,860,177	364,518	1,426,291	3,167,379	2,416,193	280,033	2,307,240	14,821,830	11,622,458
3	3,831,678	7,187,933	560,797	2,194,294	3,793,361	3,717,220	430,820	3,549,600	21,434,025	17,602,347
4	4,121,733	7,237,814	565,003	2,210,751	4,080,515	3,745,099	434,051	3,576,222	21,849,455	17,727,722
5	4,240,155	7,288,068	569,240	2,227,332	4,197,753	3,773,187	437,307	3,603,044	22,095,931	17,855,776
6	4,208,282	7,338,700	573,509	2,244,037	4,166,200	3,801,486	440,586	3,630,066	22,194,585	17,986,302
7	4,210,828	7,389,711	577,811	2,260,867	4,168,720	3,829,997	443,891	3,657,292	22,328,288	18,117,461
8	4,288,024	7,441,105	582,144	2,277,823	4,245,144	3,858,722	447,220	3,684,722	22,536,880	18,248,856
9	4,278,370	7,492,884	586,510	2,294,907	4,235,586	3,887,663	450,574	3,712,357	22,660,482	18,382,112
10	4,309,916	7,545,052	590,909	2,312,119	4,266,816	3,916,820	453,953	3,740,200	22,825,870	18,515,954
11	4,324,787	7,545,052	590,909	2,312,119	4,281,539	3,916,820	453,953	3,740,200	22,840,592	18,515,805
12	4,331,304	7,545,052	590,909	2,312,119	4,287,991	3,916,820	453,953	3,740,200	22,847,045	18,515,740
13	4,328,814	7,545,052	590,909	2,312,119	4,285,526	3,916,820	453,953	3,740,200	22,844,580	18,515,765
14	4,320,348	7,545,052	590,909	2,312,119	4,277,145	3,916,820	453,953	3,740,200	22,836,198	18,515,850
15	4,324,815	7,545,052	590,909	2,312,119	4,281,567	3,916,820	453,953	3,740,200	22,840,620	18,515,805
16	4,324,764	7,545,052	590,909	2,312,119	4,281,516	3,916,820	453,953	3,740,200	22,840,570	18,515,806
17	4,322,011	7,545,052	590,909	2,312,119	4,278,791	3,916,820	453,953	3,740,200	22,837,844	18,515,833
18	4,346,191	7,545,052	590,909	2,312,119	4,302,729	3,916,820	453,953	3,740,200	22,861,783	18,515,591
19	4,360,684	7,545,052	590,909	2,312,119	4,317,077	3,916,820	453,953	3,740,200	22,876,130	18,515,446
20	4,365,419	7,545,052	590,909	2,312,119	4,321,765	3,916,820	453,953	3,740,200	22,880,818	18,515,399
<b>NPV</b>	<b>85,062,484</b>	<b>78,028,894</b>	<b>6,059,921</b>	<b>23,711,350</b>	<b>84,211,859</b>	<b>40,167,961</b>	<b>4,655,404</b>	<b>38,356,673</b>	<b>275,192,062</b>	<b>190,129,578</b>
									Net benefit per member	22,368
									Benefit cost ratio	3.24



Table B1.2: Operating costs for broadband adoption in the Henry County REMC service area over 20 years (current \$USD)

Year	Fixed	Labor	Subscribers	Revenue	Tax	New Sub.	Billing	Churn	Bad debt	Marketing	Access Fee	Total
1	597,390	755,723	1,233	887,400	12,424	14,790	9,614	9,860	8,874	355,000	231,920	1,995,594
2	794,725	1,266,417	3,205	2,307,240	32,301	23,664	24,995	25,636	23,072	212,500	796,062	3,199,373
3	818,626	1,386,782	4,930	3,549,600	49,694	20,706	38,454	39,440	35,496	127,500	1,314,979	3,831,678
4	801,338	1,459,861	4,967	3,576,222	50,067	444	38,742	39,736	35,762	85,638	1,610,144	4,121,733
5	832,628	1,542,398	5,004	3,603,044	50,443	447	39,033	40,034	36,030	86,280	1,612,862	4,240,155
6	817,877	1,542,398	5,042	3,630,066	50,821	450	39,326	40,334	36,301	65,195	1,615,581	4,208,282
7	820,734	1,542,398	5,080	3,657,292	51,202	454	39,621	40,637	36,573	65,684	1,613,526	4,210,828
8	845,445	1,599,141	5,118	3,684,722	51,586	457	39,918	40,941	36,847	66,177	1,607,511	4,288,024
9	838,362	1,599,141	5,156	3,712,357	51,973	461	40,217	41,248	37,124	66,673	1,603,171	4,278,370
10	832,413	1,599,141	5,195	3,740,200	52,363	464	40,519	41,558	37,402	67,173	1,638,883	4,309,916
11	834,865	1,599,141	5,195	3,740,200	52,363	0	40,519	41,558	37,402	67,173	1,651,766	4,324,787
12	836,188	1,599,141	5,195	3,740,200	52,363	0	40,519	41,558	37,402	67,173	1,656,960	4,331,304
13	838,737	1,599,141	5,195	3,740,200	52,363	0	40,519	41,558	37,402	67,173	1,651,922	4,328,814
14	841,335	1,599,141	5,195	3,740,200	52,363	0	40,519	41,558	37,402	67,173	1,640,857	4,320,348
15	843,984	1,599,141	5,195	3,740,200	52,363	0	40,519	41,558	37,402	67,173	1,642,675	4,324,815
16	847,985	1,599,141	5,195	3,740,200	52,363	0	40,519	41,558	37,402	67,173	1,638,623	4,324,764
17	850,738	1,599,141	5,195	3,740,200	52,363	0	40,519	41,558	37,402	67,173	1,633,117	4,322,011
18	857,256	1,599,141	5,195	3,740,200	52,363	0	40,519	41,558	37,402	67,173	1,650,779	4,346,191
19	858,398	1,599,141	5,195	3,740,200	52,363	0	40,519	41,558	37,402	67,173	1,664,129	4,360,684
20	861,316	1,599,141	5,195	3,740,200	52,363	0	40,519	41,558	37,402	67,173	1,665,947	4,365,419

Table B1.3: Telemedicine benefits over 20 years (current \$USD) in Henry County REMC

Year	Primary Savings	Specialist	Transport	Missed Work	Pharmacy	Imaging	Web consult	Urgent	Emergency	Total
1	199,665	537,200	5,315	40,963	182,410	36,975	44,370	188,573	964,413	2,199,883
2	519,129	537,200	13,818	106,505	474,266	96,135	115,362	490,289	2,507,473	4,860,177
3	798,660	537,200	21,259	163,853	729,640	147,900	177,480	754,290	3,857,651	7,187,933
4	804,650	537,200	21,418	165,082	735,112	149,009	178,811	759,947	3,886,583	7,237,814
5	810,685	537,200	21,579	166,320	740,626	150,127	180,152	765,647	3,915,733	7,288,068
6	816,765	537,200	21,741	167,568	746,180	151,253	181,503	771,389	3,945,101	7,338,700
7	822,891	537,200	21,904	168,825	751,777	152,387	182,865	777,175	3,974,689	7,389,711
8	829,062	537,200	22,068	170,091	757,415	153,530	184,236	783,003	4,004,499	7,441,105
9	835,280	537,200	22,233	171,367	763,096	154,682	185,618	788,876	4,034,533	7,492,884
10	841,545	537,200	22,400	172,652	768,819	155,842	187,010	794,792	4,064,792	7,545,052
11	841,545	537,200	22,400	172,652	768,819	155,842	187,010	794,792	4,064,792	7,545,052
12	841,545	537,200	22,400	172,652	768,819	155,842	187,010	794,792	4,064,792	7,545,052
13	841,545	537,200	22,400	172,652	768,819	155,842	187,010	794,792	4,064,792	7,545,052
14	841,545	537,200	22,400	172,652	768,819	155,842	187,010	794,792	4,064,792	7,545,052
15	841,545	537,200	22,400	172,652	768,819	155,842	187,010	794,792	4,064,792	7,545,052
16	841,545	537,200	22,400	172,652	768,819	155,842	187,010	794,792	4,064,792	7,545,052
17	841,545	537,200	22,400	172,652	768,819	155,842	187,010	794,792	4,064,792	7,545,052
18	841,545	537,200	22,400	172,652	768,819	155,842	187,010	794,792	4,064,792	7,545,052
19	841,545	537,200	22,400	172,652	768,819	155,842	187,010	794,792	4,064,792	7,545,052
20	841,545	537,200	22,400	172,652	768,819	155,842	187,010	794,792	4,064,792	7,545,052
NPV	8,630,252	6,161,642	229,719	1,770,587	7,884,427	1,598,195	1,917,834	8,150,793	41,685,447	78,028,894

Table B2.1: Benefit Cost Summary over 20 years (current \$USD) in Jackson County REMC

Year	Total Cost	Total telemedicine	Education K-12	Adult	Multiplier	Consumer Savings	Farm Income	Revenue	Total Benefit	Net Benefit
1	103,629,484	7,412,426	909,545	1,654,172	102,593,190	2,646,114	286,208	2,526,793	118,028,447	14,398,963
2	6,341,825	15,101,107	2,364,816	4,300,848	6,278,406	6,879,896	744,141	6,569,662	42,238,877	35,897,052
3	7,948,508	21,828,703	3,638,179	6,616,689	7,869,023	10,584,456	1,144,832	10,107,173	61,789,054	53,840,546
4	8,699,486	21,972,865	3,665,465	6,666,314	8,612,492	10,663,839	1,153,418	10,182,977	62,917,370	54,217,884
5	8,883,815	22,118,109	3,692,956	6,716,311	8,794,977	10,743,818	1,162,069	10,259,349	63,487,589	54,603,775
6	8,812,872	22,264,443	3,720,653	6,766,684	8,724,744	10,824,397	1,170,784	10,336,294	63,807,999	54,995,126
7	8,816,283	22,411,874	3,748,558	6,817,434	8,728,120	10,905,580	1,179,565	10,413,816	64,204,947	55,388,664
8	8,926,698	22,560,410	3,776,673	6,868,564	8,837,431	10,987,372	1,188,412	10,491,920	64,710,781	55,784,084
9	8,908,722	22,710,061	3,804,998	6,920,079	8,819,635	11,069,777	1,197,325	10,570,609	65,092,483	56,183,761
10	9,006,535	22,860,834	3,833,535	6,971,979	8,916,470	11,152,800	1,206,305	10,649,889	65,591,812	56,585,277
11	9,045,763	22,861,501	3,833,662	6,972,209	8,955,306	11,153,168	1,206,345	10,650,240	65,632,431	56,586,667
12	9,062,539	22,861,501	3,833,662	6,972,209	8,971,914	11,153,168	1,206,345	10,650,240	65,649,039	56,586,500
13	9,052,026	22,861,501	3,833,662	6,972,209	8,961,505	11,153,168	1,206,345	10,650,240	65,638,630	56,586,605
14	9,024,428	22,861,501	3,833,662	6,972,209	8,934,184	11,153,168	1,206,345	10,650,240	65,611,308	56,586,881
15	9,033,590	22,861,501	3,833,662	6,972,209	8,943,254	11,153,168	1,206,345	10,650,240	65,620,379	56,586,789
16	9,028,071	22,861,501	3,833,662	6,972,209	8,937,790	11,153,168	1,206,345	10,650,240	65,614,915	56,586,844
17	9,016,533	22,861,501	3,833,662	6,972,209	8,926,368	11,153,168	1,206,345	10,650,240	65,603,493	56,586,960
18	9,076,633	22,861,501	3,833,662	6,972,209	8,985,866	11,153,168	1,206,345	10,650,240	65,662,991	56,586,359
19	9,116,366	22,861,501	3,833,662	6,972,209	9,025,202	11,153,168	1,206,345	10,650,240	65,702,327	56,585,961
20	9,125,932	22,861,501	3,833,662	6,972,209	9,034,673	11,153,168	1,206,345	10,650,240	65,711,798	56,585,866
<b>NPV</b>	<b>188,804,610</b>	<b>237,612,900</b>	<b>39,314,370</b>	<b>71,500,316</b>	<b>186,916,564</b>	<b>114,376,235</b>	<b>12,371,120</b>	<b>109,218,686</b>	<b>771,310,191</b>	<b>582,505,581</b>
									Net benefit per member	24,067
									Benefit cost ratio	4.09



Table B2.2: Operating costs for broadband adoption in the Jackson County REMC service area over 20 years (current \$USD)

Year	Fixed	Labor	Subscribers	Revenue	Tax	New Sub.	Billing	Churn	Bad debt	Marketing	Access Fee	Total
1	898,723	1,136,921	3,509	2,526,793	35,375	42,113	27,374	28,075	25,268	826,090	660,370	3,680,310
2	1,195,596	1,905,216	9,125	6,569,662	91,975	67,381	71,171	72,996	65,697	605,075	2,266,716	6,341,825
3	1,231,554	2,086,296	14,038	10,107,173	141,500	58,959	109,494	112,302	101,072	363,045	3,744,286	7,948,508
4	1,205,545	2,196,237	14,143	10,182,977	142,562	1,263	110,316	113,144	101,830	243,845	4,584,744	8,699,486
5	1,252,618	2,320,406	14,249	10,259,349	143,631	1,273	111,143	113,993	102,593	245,674	4,592,484	8,883,815
6	1,230,426	2,320,406	14,356	10,336,294	144,708	1,282	111,977	114,848	103,363	185,637	4,600,225	8,812,872
7	1,234,725	2,320,406	14,464	10,413,816	145,793	1,292	112,816	115,709	104,138	187,030	4,594,373	8,816,283
8	1,271,900	2,405,772	14,572	10,491,920	146,887	1,302	113,662	116,577	104,919	188,432	4,577,246	8,926,698
9	1,261,244	2,405,772	14,681	10,570,609	147,989	1,311	114,515	117,451	105,706	189,846	4,564,888	8,908,722
10	1,252,294	2,405,772	14,792	10,649,889	149,098	1,321	115,374	118,332	106,499	191,270	4,666,574	9,006,535
11	1,255,984	2,405,772	14,792	10,650,240	149,103	6	115,378	118,336	106,502	191,270	4,703,412	9,045,763
12	1,257,974	2,405,772	14,792	10,650,240	149,103	0	115,378	118,336	106,502	191,270	4,718,204	9,062,539
13	1,261,808	2,405,772	14,792	10,650,240	149,103	0	115,378	118,336	106,502	191,270	4,703,856	9,052,026
14	1,265,717	2,405,772	14,792	10,650,240	149,103	0	115,378	118,336	106,502	191,270	4,672,349	9,024,428
15	1,269,703	2,405,772	14,792	10,650,240	149,103	0	115,378	118,336	106,502	191,270	4,677,526	9,033,590
16	1,275,721	2,405,772	14,792	10,650,240	149,103	0	115,378	118,336	106,502	191,270	4,665,988	9,028,071
17	1,279,863	2,405,772	14,792	10,650,240	149,103	0	115,378	118,336	106,502	191,270	4,650,309	9,016,533
18	1,289,669	2,405,772	14,792	10,650,240	149,103	0	115,378	118,336	106,502	191,270	4,700,602	9,076,633
19	1,291,388	2,405,772	14,792	10,650,240	149,103	0	115,378	118,336	106,502	191,270	4,738,617	9,116,366
20	1,295,776	2,405,772	14,792	10,650,240	149,103	0	115,378	118,336	106,502	191,270	4,743,794	9,125,932

Table B2.3: Telemedicine benefits over 20 years (current \$USD) in Jackson County REMC

Year	Primary Savings	Specialist	Transport	Missed Work	Pharmacy	Imaging	Web consult	Urgent	Emergency	Total
1	568,528	2,607,000	34,340	168,514	519,396	105,283	126,340	536,944	2,746,080	7,412,426
2	1,478,174	2,607,000	89,285	438,136	1,350,431	273,736	328,483	1,396,053	7,139,809	15,101,107
3	2,274,114	2,607,000	137,361	674,056	2,077,586	421,132	505,359	2,147,774	10,984,321	21,828,703
4	2,291,170	2,607,000	138,392	679,111	2,093,167	424,291	509,149	2,163,883	11,066,703	21,972,865
5	2,308,354	2,607,000	139,430	684,205	2,108,866	427,473	512,967	2,180,112	11,149,704	22,118,109
6	2,325,666	2,607,000	140,475	689,336	2,124,683	430,679	516,815	2,196,462	11,233,326	22,264,443
7	2,343,109	2,607,000	141,529	694,506	2,140,618	433,909	520,691	2,212,936	11,317,576	22,411,874
8	2,360,682	2,607,000	142,590	699,715	2,156,672	437,163	524,596	2,229,533	11,402,458	22,560,410
9	2,378,387	2,607,000	143,660	704,963	2,172,847	440,442	528,530	2,246,254	11,487,977	22,710,061
10	2,396,225	2,607,000	144,737	710,250	2,189,144	443,745	532,494	2,263,101	11,574,136	22,860,834
11	2,396,304	2,607,000	144,742	710,273	2,189,216	443,760	532,512	2,263,176	11,574,518	22,861,501
12	2,396,304	2,607,000	144,742	710,273	2,189,216	443,760	532,512	2,263,176	11,574,518	22,861,501
13	2,396,304	2,607,000	144,742	710,273	2,189,216	443,760	532,512	2,263,176	11,574,518	22,861,501
14	2,396,304	2,607,000	144,742	710,273	2,189,216	443,760	532,512	2,263,176	11,574,518	22,861,501
15	2,396,304	2,607,000	144,742	710,273	2,189,216	443,760	532,512	2,263,176	11,574,518	22,861,501
16	2,396,304	2,607,000	144,742	710,273	2,189,216	443,760	532,512	2,263,176	11,574,518	22,861,501
17	2,396,304	2,607,000	144,742	710,273	2,189,216	443,760	532,512	2,263,176	11,574,518	22,861,501
18	2,396,304	2,607,000	144,742	710,273	2,189,216	443,760	532,512	2,263,176	11,574,518	22,861,501
19	2,396,304	2,607,000	144,742	710,273	2,189,216	443,760	532,512	2,263,176	11,574,518	22,861,501
20	2,396,304	2,607,000	144,742	710,273	2,189,216	443,760	532,512	2,263,176	11,574,518	22,861,501
<b>NPV</b>	<b>24,574,204</b>	<b>29,902,085</b>	<b>1,484,335</b>	<b>7,283,885</b>	<b>22,450,508</b>	<b>4,550,779</b>	<b>5,460,934</b>	<b>23,208,971</b>	<b>118,697,200</b>	<b>237,612,900</b>



Table B3.1: Benefit Cost Summary over 20 years (current \$USD) in Marshall County REMC

Year	Total Cost	Total telemedicine	Education K-12	Adult	Multiplier	Consumer Savings	Farm Income	Revenue	Total Benefit	Net Benefit
1	43,938,767	1,735,255	139,642	522,662	43,499,379	792,533	135,629	756,796	47,581,895	3,643,128
2	2,948,977	4,006,062	363,069	1,358,921	2,919,487	2,060,586	352,635	1,967,669	13,028,429	10,079,452
3	3,503,654	5,993,019	558,567	2,090,648	3,468,617	3,170,133	542,515	3,027,182	18,850,681	15,347,027
4	3,756,987	6,035,596	562,756	2,106,328	3,719,418	3,193,909	546,584	3,049,886	19,214,477	15,457,489
5	3,870,156	6,078,493	566,977	2,122,125	3,831,455	3,217,863	550,683	3,072,760	19,440,357	15,570,201
6	3,841,397	6,121,712	571,229	2,138,041	3,802,983	3,241,997	554,813	3,095,806	19,526,582	15,685,185
7	3,843,873	6,165,255	575,514	2,154,076	3,805,435	3,266,312	558,974	3,119,025	19,644,591	15,800,717
8	3,918,421	6,209,124	579,830	2,170,232	3,879,237	3,290,809	563,167	3,142,417	19,834,816	15,916,395
9	3,909,430	6,253,323	584,179	2,186,509	3,870,336	3,315,490	567,391	3,165,985	19,943,212	16,033,782
10	3,935,697	6,297,853	588,560	2,202,908	3,896,340	3,340,357	571,646	3,189,730	20,087,393	16,151,696
11	3,949,006	6,297,608	588,536	2,202,818	3,909,516	3,340,220	571,623	3,189,600	20,099,920	16,150,914
12	3,955,140	6,297,608	588,536	2,202,818	3,915,589	3,340,220	571,623	3,189,600	20,105,993	16,150,853
13	3,953,726	6,297,608	588,536	2,202,818	3,914,188	3,340,220	571,623	3,189,600	20,104,593	16,150,867
14	3,947,223	6,297,608	588,536	2,202,818	3,907,751	3,340,220	571,623	3,189,600	20,098,155	16,150,932
15	3,951,759	6,297,608	588,536	2,202,818	3,912,241	3,340,220	571,623	3,189,600	20,102,645	16,150,887
16	3,952,589	6,297,608	588,536	2,202,818	3,913,063	3,340,220	571,623	3,189,600	20,103,467	16,150,878
17	3,950,985	6,297,608	588,536	2,202,818	3,911,475	3,340,220	571,623	3,189,600	20,101,879	16,150,894
18	3,972,756	6,297,608	588,536	2,202,818	3,933,029	3,340,220	571,623	3,189,600	20,123,433	16,150,677
19	3,985,693	6,297,608	588,536	2,202,818	3,945,837	3,340,220	571,623	3,189,600	20,136,241	16,150,547
20	3,990,503	6,297,608	588,536	2,202,818	3,950,598	3,340,220	571,623	3,189,600	20,141,003	16,150,499
<b>NPV</b>	<b>81,391,338</b>	<b>64,968,868</b>	<b>6,035,729</b>	<b>22,590,991</b>	<b>80,577,424</b>	<b>34,255,621</b>	<b>5,862,275</b>	<b>32,710,938</b>	<b>247,001,846</b>	<b>165,610,509</b>
									Net benefit per member	22,846
									Benefit cost ratio	3.03





Table B3.2: Operating costs for broadband adoption in the Marshall County REMC service area over 20 years (current \$USD)

Year	Fixed	Labor	Subscribers	Revenue	Tax	New Sub.	Billing	Churn	Bad debt	Marketing	Access Fee	Total
1	573,370	725,337	1,051	756,796	10,595	12,613	8,199	8,409	7,568	317,470	197,786	1,861,348
2	762,771	1,215,497	2,733	1,967,669	27,547	20,181	21,316	21,863	19,677	181,225	678,900	2,948,977
3	785,711	1,331,022	4,204	3,027,182	42,381	17,659	32,794	33,635	30,272	108,735	1,121,445	3,503,654
4	769,118	1,401,163	4,236	3,049,886	42,698	378	33,040	33,888	30,499	73,034	1,373,169	3,756,987
5	799,149	1,480,381	4,268	3,072,760	43,019	381	33,288	34,142	30,728	73,581	1,375,487	3,870,156
6	784,991	1,480,381	4,300	3,095,806	43,341	384	33,538	34,398	30,958	55,600	1,377,806	3,841,397
7	787,734	1,480,381	4,332	3,119,025	43,666	387	33,789	34,656	31,190	56,017	1,376,053	3,843,873
8	811,451	1,534,843	4,364	3,142,417	43,994	390	34,043	34,916	31,424	56,437	1,370,923	3,918,421
9	804,653	1,534,843	4,397	3,165,985	44,324	393	34,298	35,178	31,660	56,860	1,367,222	3,909,430
10	798,943	1,534,843	4,430	3,189,730	44,656	396	34,555	35,441	31,897	57,287	1,397,678	3,935,697
11	801,297	1,534,843	4,430	3,189,600	44,654	-2	34,554	35,440	31,896	57,716	1,408,607	3,949,006
12	802,567	1,534,843	4,430	3,189,600	44,654	0	34,554	35,440	31,896	58,149	1,413,037	3,955,140
13	805,013	1,534,843	4,430	3,189,600	44,654	0	34,554	35,440	31,896	58,585	1,408,740	3,953,726
14	807,507	1,534,843	4,430	3,189,600	44,654	0	34,554	35,440	31,896	59,025	1,399,304	3,947,223
15	810,049	1,534,843	4,430	3,189,600	44,654	0	34,554	35,440	31,896	59,468	1,400,855	3,951,759
16	813,889	1,534,843	4,430	3,189,600	44,654	0	34,554	35,440	31,896	59,914	1,397,399	3,952,589
17	816,531	1,534,843	4,430	3,189,600	44,654	0	34,554	35,440	31,896	60,363	1,392,703	3,950,985
18	822,788	1,534,843	4,430	3,189,600	44,654	0	34,554	35,440	31,896	60,816	1,407,765	3,972,756
19	823,884	1,534,843	4,430	3,189,600	44,654	0	34,554	35,440	31,896	61,272	1,419,151	3,985,693
20	826,684	1,534,843	4,430	3,189,600	44,654	0	34,554	35,440	31,896	61,731	1,420,701	3,990,503

Table B3.3: Telemedicine benefits over 20 years (current \$USD) in Marshall County REMC

Year	Primary Savings	Specialist	Transport	Missed Work	Pharmacy	Imaging	Web Consult	Urgent	Emergency	Total
1	170,279	316,000	3,672	37,074	155,564	31,533	37,840	160,819	822,474	1,735,255
2	442,725	316,000	9,547	96,393	404,465	81,986	98,383	418,130	2,138,432	4,006,062
3	681,116	316,000	14,688	148,297	622,254	126,133	151,359	643,276	3,289,896	5,993,019
4	686,224	316,000	14,799	149,409	626,921	127,079	152,494	648,101	3,314,570	6,035,596
5	691,371	316,000	14,910	150,529	631,623	128,032	153,638	652,962	3,339,429	6,078,493
6	696,556	316,000	15,021	151,658	636,360	128,992	154,790	657,859	3,364,475	6,121,712
7	701,781	316,000	15,134	152,796	641,133	129,959	155,951	662,793	3,389,708	6,165,255
8	707,044	316,000	15,247	153,942	645,941	130,934	157,121	667,764	3,415,131	6,209,124
9	712,347	316,000	15,362	155,096	650,786	131,916	158,299	672,772	3,440,745	6,253,323
10	717,689	316,000	15,477	156,260	655,667	132,905	159,487	677,818	3,466,550	6,297,853
11	717,660	316,000	15,476	156,253	655,640	132,900	159,480	677,790	3,466,409	6,297,608
12	717,660	316,000	15,476	156,253	655,640	132,900	159,480	677,790	3,466,409	6,297,608
13	717,660	316,000	15,476	156,253	655,640	132,900	159,480	677,790	3,466,409	6,297,608
14	717,660	316,000	15,476	156,253	655,640	132,900	159,480	677,790	3,466,409	6,297,608
15	717,660	316,000	15,476	156,253	655,640	132,900	159,480	677,790	3,466,409	6,297,608
16	717,660	316,000	15,476	156,253	655,640	132,900	159,480	677,790	3,466,409	6,297,608
17	717,660	316,000	15,476	156,253	655,640	132,900	159,480	677,790	3,466,409	6,297,608
18	717,660	316,000	15,476	156,253	655,640	132,900	159,480	677,790	3,466,409	6,297,608
19	717,660	316,000	15,476	156,253	655,640	132,900	159,480	677,790	3,466,409	6,297,608
20	717,660	316,000	15,476	156,253	655,640	132,900	159,480	677,790	3,466,409	6,297,608
<b>NPV</b>	<b>7,359,961</b>	<b>3,624,495</b>	<b>158,718</b>	<b>1,602,454</b>	<b>6,723,915</b>	<b>1,362,956</b>	<b>1,635,547</b>	<b>6,951,074</b>	<b>35,549,747</b>	<b>64,968,868</b>

Table B4.1: Benefit Cost Summary over 20 years (current \$USD) in Noble County REMC

Year	Total Cost	Total telemedicine	Education K-12	Adult	Multiplier	Consumer Savings	Farm Income	Revenue	Total Benefit	Net Benefit
1	52,367,730	3,342,179	162,908	757,973	51,844,053	1,163,927	103,178	1,111,442	58,485,660	6,117,930
2	3,628,767	6,692,547	423,561	1,970,729	3,592,479	3,026,211	268,262	2,889,750	18,863,539	15,234,772
3	4,394,228	9,624,118	651,633	3,031,891	4,350,286	4,655,709	412,710	4,445,770	27,172,117	22,777,888
4	4,747,272	9,686,937	656,520	3,054,631	4,699,799	4,690,627	415,805	4,479,113	27,683,432	22,936,160
5	4,874,698	9,750,228	661,444	3,077,540	4,825,951	4,725,806	418,924	4,512,706	27,972,599	23,097,902
6	4,837,487	9,813,993	666,405	3,100,622	4,789,112	4,761,250	422,066	4,546,552	28,099,999	23,262,512
7	4,840,150	9,878,236	671,403	3,123,877	4,791,749	4,796,959	425,231	4,580,651	28,268,106	23,427,956
8	4,921,883	9,942,962	676,439	3,147,306	4,872,665	4,832,936	428,421	4,615,006	28,515,733	23,593,849
9	4,911,093	10,008,172	681,512	3,170,910	4,861,982	4,869,183	431,634	4,649,618	28,673,011	23,761,919
10	4,951,695	10,073,872	686,623	3,194,692	4,902,178	4,905,702	434,871	4,684,490	28,882,429	23,930,734
11	4,969,784	10,073,552	686,598	3,194,576	4,920,087	4,905,524	434,855	4,684,320	28,899,512	23,929,727
12	4,977,707	10,073,552	686,598	3,194,576	4,927,930	4,905,524	434,855	4,684,320	28,907,355	23,929,648
13	4,974,121	10,073,552	686,598	3,194,576	4,924,380	4,905,524	434,855	4,684,320	28,903,805	23,929,684
14	4,963,041	10,073,552	686,598	3,194,576	4,913,410	4,905,524	434,855	4,684,320	28,892,835	23,929,795
15	4,968,149	10,073,552	686,598	3,194,576	4,918,468	4,905,524	434,855	4,684,320	28,897,893	23,929,744
16	4,967,351	10,073,552	686,598	3,194,576	4,917,677	4,905,524	434,855	4,684,320	28,897,102	23,929,752
17	4,963,397	10,073,552	686,598	3,194,576	4,913,763	4,905,524	434,855	4,684,320	28,893,188	23,929,791
18	4,992,485	10,073,552	686,598	3,194,576	4,942,560	4,905,524	434,855	4,684,320	28,921,985	23,929,500
19	5,010,426	10,073,552	686,598	3,194,576	4,960,322	4,905,524	434,855	4,684,320	28,939,747	23,929,321
20	5,015,822	10,073,552	686,598	3,194,576	4,965,664	4,905,524	434,855	4,684,320	28,945,089	23,929,267
<b>NPV</b>	<b>99,574,368</b>	<b>104,824,889</b>	<b>7,041,388</b>	<b>32,761,881</b>	<b>98,578,624</b>	<b>50,308,457</b>	<b>4,459,644</b>	<b>48,039,906</b>	<b>346,014,789</b>	<b>246,440,421</b>
									Net benefit per member	23,149
									Benefit cost ratio	3.47



Table B4.2: Operating costs for broadband adoption in the Noble County REMC service area over 20 years (current \$USD)

Year	Fixed	Labor	Subscribers	Revenue	Tax	New Sub.	Billing	Churn	Bad debt	Marketing	Access Fee	Total
1	638,554	807,797	1,544	1,111,442	15,560	18,524	12,041	12,349	11,114	419,380	290,472	2,225,792
2	849,486	1,353,680	4,014	2,889,750	40,457	29,638	31,306	32,108	28,898	266,150	997,044	3,628,767
3	875,034	1,482,340	6,175	4,445,770	62,241	25,934	48,163	49,397	44,458	159,690	1,646,972	4,394,228
4	856,555	1,560,454	6,221	4,479,113	62,708	556	48,524	49,768	44,791	107,258	2,016,658	4,747,272
5	890,001	1,648,678	6,268	4,512,706	63,178	560	48,888	50,141	45,127	108,063	2,020,063	4,874,698
6	874,233	1,648,678	6,315	4,546,552	63,652	564	49,254	50,517	45,466	81,655	2,023,468	4,837,487
7	877,287	1,648,678	6,362	4,580,651	64,129	568	49,624	50,896	45,807	82,267	2,020,894	4,840,150
8	903,701	1,709,331	6,410	4,615,006	64,610	573	49,996	51,278	46,150	82,884	2,013,360	4,921,883
9	896,129	1,709,331	6,458	4,649,618	65,095	577	50,371	51,662	46,496	83,506	2,007,925	4,911,093
10	889,771	1,709,331	6,506	4,684,490	65,583	581	50,749	52,050	46,845	84,132	2,052,653	4,951,695
11	892,392	1,709,331	6,506	4,684,320	65,580	-3	50,747	52,048	46,843	84,132	2,068,713	4,969,784
12	893,806	1,709,331	6,506	4,684,320	65,580	0	50,747	52,048	46,843	84,132	2,075,219	4,977,707
13	896,531	1,709,331	6,506	4,684,320	65,580	0	50,747	52,048	46,843	84,132	2,068,908	4,974,121
14	899,308	1,709,331	6,506	4,684,320	65,580	0	50,747	52,048	46,843	84,132	2,055,050	4,963,041
15	902,140	1,709,331	6,506	4,684,320	65,580	0	50,747	52,048	46,843	84,132	2,057,327	4,968,149
16	906,416	1,709,331	6,506	4,684,320	65,580	0	50,747	52,048	46,843	84,132	2,052,253	4,967,351
17	909,359	1,709,331	6,506	4,684,320	65,580	0	50,747	52,048	46,843	84,132	2,045,356	4,963,397
18	916,326	1,709,331	6,506	4,684,320	65,580	0	50,747	52,048	46,843	84,132	2,067,477	4,992,485
19	917,547	1,709,331	6,506	4,684,320	65,580	0	50,747	52,048	46,843	84,132	2,084,197	5,010,426
20	920,665	1,709,331	6,506	4,684,320	65,580	0	50,747	52,048	46,843	84,132	2,086,474	5,015,822



Table B4.3: Telemedicine benefits over 20 years (current \$USD) in Noble County REMC

Year	Primary Savings	Specialist	Transport	Missed Work	Pharmacy	Imaging	Web Consult	Urgent	Emergency	Total
1	250,075	1,248,200	8,432	61,047	228,463	46,310	55,572	236,182	1,207,899	3,342,179
2	650,194	1,248,200	21,923	158,723	594,004	120,406	144,488	614,072	3,140,536	6,692,547
3	1,000,298	1,248,200	33,728	244,189	913,853	185,240	222,288	944,726	4,831,594	9,624,118
4	1,007,800	1,248,200	33,981	246,021	920,707	186,630	223,956	951,811	4,867,831	9,686,937
5	1,015,359	1,248,200	34,236	247,866	927,612	188,029	225,635	958,950	4,904,340	9,750,228
6	1,022,974	1,248,200	34,493	249,725	934,569	189,440	227,328	966,142	4,941,123	9,813,993
7	1,030,646	1,248,200	34,752	251,598	941,578	190,860	229,033	973,388	4,978,181	9,878,236
8	1,038,376	1,248,200	35,012	253,485	948,640	192,292	230,750	980,689	5,015,518	9,942,962
9	1,046,164	1,248,200	35,275	255,386	955,755	193,734	232,481	988,044	5,053,134	10,008,172
10	1,054,010	1,248,200	35,539	257,301	962,923	195,187	234,225	995,454	5,091,032	10,073,872
11	1,053,972	1,248,200	35,538	257,292	962,888	195,180	234,216	995,418	5,090,847	10,073,552
12	1,053,972	1,248,200	35,538	257,292	962,888	195,180	234,216	995,418	5,090,847	10,073,552
13	1,053,972	1,248,200	35,538	257,292	962,888	195,180	234,216	995,418	5,090,847	10,073,552
14	1,053,972	1,248,200	35,538	257,292	962,888	195,180	234,216	995,418	5,090,847	10,073,552
15	1,053,972	1,248,200	35,538	257,292	962,888	195,180	234,216	995,418	5,090,847	10,073,552
16	1,053,972	1,248,200	35,538	257,292	962,888	195,180	234,216	995,418	5,090,847	10,073,552
17	1,053,972	1,248,200	35,538	257,292	962,888	195,180	234,216	995,418	5,090,847	10,073,552
18	1,053,972	1,248,200	35,538	257,292	962,888	195,180	234,216	995,418	5,090,847	10,073,552
19	1,053,972	1,248,200	35,538	257,292	962,888	195,180	234,216	995,418	5,090,847	10,073,552
20	1,053,972	1,248,200	35,538	257,292	962,888	195,180	234,216	995,418	5,090,847	10,073,552
<b>NPV</b>	<b>10,808,979</b>	<b>14,316,756</b>	<b>364,459</b>	<b>2,638,652</b>	<b>9,874,870</b>	<b>2,001,663</b>	<b>2,401,995</b>	<b>10,208,480</b>	<b>52,209,036</b>	<b>104,824,889</b>

Table B5.1: Benefit Cost Summary over 20 years (current \$USD) in Orange County REMC

Year	Total Cost	Total telemedicine	Education K-12	Adult	Multiplier	Consumer Savings	Farm Income	Revenue	Total Benefit	Net Benefit
1	45,598,187	1,881,423	86,166	492,539	45,142,205	847,963	17,953	809,726	49,277,976	3,679,789
2	3,050,453	4,310,261	224,033	1,280,600	3,019,948	2,204,705	46,677	2,105,289	13,191,512	10,141,059
3	3,636,590	6,435,493	344,666	1,970,154	3,600,224	3,391,854	71,810	3,238,906	19,053,107	15,416,517
4	3,904,806	6,481,034	347,251	1,984,930	3,865,758	3,417,293	72,349	3,263,197	19,431,812	15,527,006
5	4,020,103	6,526,916	349,855	1,999,817	3,979,902	3,442,923	72,891	3,287,671	19,659,976	15,639,873
6	3,990,082	6,573,143	352,479	2,014,816	3,950,181	3,468,744	73,438	3,312,329	19,745,130	15,755,048
7	3,992,587	6,619,716	355,123	2,029,927	3,952,661	3,494,760	73,989	3,337,171	19,863,347	15,870,760
8	4,068,207	6,666,638	357,786	2,045,152	4,027,525	3,520,971	74,544	3,362,200	20,054,816	15,986,608
9	4,058,948	6,713,912	360,470	2,060,490	4,018,358	3,547,378	75,103	3,387,417	20,163,128	16,104,180
10	4,087,354	6,761,541	363,173	2,075,944	4,046,480	3,573,983	75,666	3,412,822	20,309,610	16,222,256
11	4,101,068	6,761,499	363,171	2,075,930	4,060,058	3,573,960	75,665	3,412,800	20,323,084	16,222,015
12	4,107,100	6,761,499	363,171	2,075,930	4,066,029	3,573,960	75,665	3,412,800	20,329,055	16,221,955
13	4,104,990	6,761,499	363,171	2,075,930	4,063,940	3,573,960	75,665	3,412,800	20,326,966	16,221,976
14	4,097,430	6,761,499	363,171	2,075,930	4,056,456	3,573,960	75,665	3,412,800	20,319,482	16,222,052
15	4,101,675	6,761,499	363,171	2,075,930	4,060,658	3,573,960	75,665	3,412,800	20,323,684	16,222,009
16	4,101,882	6,761,499	363,171	2,075,930	4,060,864	3,573,960	75,665	3,412,800	20,323,890	16,222,007
17	4,099,545	6,761,499	363,171	2,075,930	4,058,550	3,573,960	75,665	3,412,800	20,321,576	16,222,030
18	4,122,024	6,761,499	363,171	2,075,930	4,080,804	3,573,960	75,665	3,412,800	20,343,830	16,221,806
19	4,135,320	6,761,499	363,171	2,075,930	4,093,967	3,573,960	75,665	3,412,800	20,356,993	16,221,673
20	4,551,381	6,761,499	363,171	2,075,930	4,505,867	3,573,960	75,665	3,412,800	20,768,893	16,217,512
<b>NPV</b>	<b>84,604,880</b>	<b>69,782,517</b>	<b>3,724,420</b>	<b>21,289,263</b>	<b>83,758,831</b>	<b>36,651,987</b>	<b>775,971</b>	<b>34,999,245</b>	<b>250,982,233</b>	<b>166,377,353</b>
									Net benefit per member	21,451
									Benefit cost ratio	2.97



Table B5.2: Operating costs for broadband adoption in the Orange County REMC service area over 20 years (current \$USD)

Year	Fixed	Labor	Subscribers	Revenue	Tax	New Sub.	Billing	Churn	Bad debt	Marketing	Access Fee	Total
1	583,104	737,650	1,125	809,726	11,336	13,495	8,772	8,997	8,097	332,680	211,620	1,915,752
2	775,720	1,236,131	2,924	2,105,289	29,474	21,593	22,807	23,392	21,053	193,900	726,383	3,050,453
3	799,049	1,353,618	4,498	3,238,906	45,345	18,894	35,088	35,988	32,389	116,340	1,199,880	3,636,590
4	782,175	1,424,949	4,532	3,263,197	45,685	405	35,351	36,258	32,632	78,142	1,469,209	3,904,806
5	812,716	1,505,512	4,566	3,287,671	46,027	408	35,616	36,530	32,877	78,728	1,471,690	4,020,103
6	798,317	1,505,512	4,600	3,312,329	46,373	411	35,884	36,804	33,123	59,489	1,474,170	3,990,082
7	801,106	1,505,512	4,635	3,337,171	46,720	414	36,153	37,080	33,372	59,935	1,472,295	3,992,587
8	825,226	1,560,899	4,670	3,362,200	47,071	417	36,424	37,358	33,622	60,384	1,466,807	4,068,207
9	818,312	1,560,899	4,705	3,387,417	47,424	420	36,697	37,638	33,874	60,837	1,462,846	4,058,948
10	812,506	1,560,899	4,740	3,412,822	47,780	423	36,972	37,920	34,128	61,294	1,495,432	4,087,354
11	814,900	1,560,899	4,740	3,412,800	47,779	0	36,972	37,920	34,128	61,294	1,507,178	4,101,068
12	816,191	1,560,899	4,740	3,412,800	47,779	0	36,972	37,920	34,128	61,294	1,511,918	4,107,100
13	818,679	1,560,899	4,740	3,412,800	47,779	0	36,972	37,920	34,128	61,294	1,507,320	4,104,990
14	821,215	1,560,899	4,740	3,412,800	47,779	0	36,972	37,920	34,128	61,294	1,497,224	4,097,430
15	823,801	1,560,899	4,740	3,412,800	47,779	0	36,972	37,920	34,128	61,294	1,498,883	4,101,675
16	827,706	1,560,899	4,740	3,412,800	47,779	0	36,972	37,920	34,128	61,294	1,495,186	4,101,882
17	830,393	1,560,899	4,740	3,412,800	47,779	0	36,972	37,920	34,128	61,294	1,490,161	4,099,545
18	836,755	1,560,899	4,740	3,412,800	47,779	0	36,972	37,920	34,128	61,294	1,506,277	4,122,024
19	837,870	1,560,899	4,740	3,412,800	47,779	0	36,972	37,920	34,128	61,294	1,518,459	4,135,320
20	1,252,271	1,560,899	4,740	3,412,800	47,779	0	36,972	37,920	34,128	61,294	1,520,118	4,551,381





Table B5.3: Telemedicine benefits over 20 years (current \$USD) in Orange County REMC

Year	Primary Savings	Specialist	Transport	Missed Work	Pharmacy	Imaging	Web Consult	Urgent	Emergency	Total
1	182,188	363,400	5,271	37,830	166,444	33,739	40,486	172,067	879,998	1,881,423
2	473,690	363,400	13,704	98,359	432,754	87,720	105,264	447,374	2,287,996	4,310,261
3	728,754	363,400	21,083	151,322	665,775	134,954	161,945	688,267	3,519,993	6,435,493
4	734,219	363,400	21,241	152,457	670,768	135,967	163,160	693,429	3,546,393	6,481,034
5	739,726	363,400	21,400	153,600	675,799	136,986	164,384	698,630	3,572,991	6,526,916
6	745,274	363,400	21,561	154,752	680,868	138,014	165,616	703,870	3,599,788	6,573,143
7	750,864	363,400	21,722	155,913	685,974	139,049	166,859	709,149	3,626,787	6,619,716
8	756,495	363,400	21,885	157,082	691,119	140,092	168,110	714,468	3,653,988	6,666,638
9	762,169	363,400	22,049	158,260	696,302	141,142	169,371	719,826	3,681,393	6,713,912
10	767,885	363,400	22,215	159,447	701,525	142,201	170,641	725,225	3,709,003	6,761,541
11	767,880	363,400	22,214	159,446	701,520	142,200	170,640	725,220	3,708,979	6,761,499
12	767,880	363,400	22,214	159,446	701,520	142,200	170,640	725,220	3,708,979	6,761,499
13	767,880	363,400	22,214	159,446	701,520	142,200	170,640	725,220	3,708,979	6,761,499
14	767,880	363,400	22,214	159,446	701,520	142,200	170,640	725,220	3,708,979	6,761,499
15	767,880	363,400	22,214	159,446	701,520	142,200	170,640	725,220	3,708,979	6,761,499
16	767,880	363,400	22,214	159,446	701,520	142,200	170,640	725,220	3,708,979	6,761,499
17	767,880	363,400	22,214	159,446	701,520	142,200	170,640	725,220	3,708,979	6,761,499
18	767,880	363,400	22,214	159,446	701,520	142,200	170,640	725,220	3,708,979	6,761,499
19	767,880	363,400	22,214	159,446	701,520	142,200	170,640	725,220	3,708,979	6,761,499
20	767,880	363,400	22,214	159,446	701,520	142,200	170,640	725,220	3,708,979	6,761,499
<b>NPV</b>	<b>7,874,830</b>	<b>4,168,169</b>	<b>227,816</b>	<b>1,635,165</b>	<b>7,194,289</b>	<b>1,458,302</b>	<b>1,749,962</b>	<b>7,437,340</b>	<b>38,036,644</b>	<b>69,782,517</b>

Table B6.1: Benefit Cost Summary over 20 years (current \$USD) in Whitewater REMC

Year	Total Cost	Total telemedicine	Education K-12	Adult	Multiplier	Consumer Savings	Farm Income	Revenue	Total Benefit	Net Benefit
1	70,705,827	8,668,920	282,797	753,775	69,998,769	1,283,644	385,781	1,225,760	82,599,445	11,893,618
2	3,847,873	12,351,352	735,271	1,959,814	3,809,394	3,337,473	1,003,031	3,186,977	26,383,312	22,535,439
3	4,681,278	15,573,479	1,131,187	3,015,098	4,634,465	5,134,574	1,543,125	4,903,042	35,934,970	31,253,692
4	5,066,462	15,642,525	1,139,670	3,037,711	5,015,797	5,173,083	1,554,698	4,939,814	36,503,300	31,436,838
5	5,198,482	15,712,088	1,148,218	3,060,494	5,146,497	5,211,882	1,566,359	4,976,863	36,822,401	31,623,919
6	5,158,546	15,782,173	1,156,830	3,083,448	5,106,961	5,250,971	1,578,106	5,014,189	36,972,679	31,814,132
7	5,161,270	15,852,784	1,165,506	3,106,574	5,109,658	5,290,353	1,589,942	5,051,796	37,166,613	32,005,342
8	5,245,319	15,923,925	1,174,247	3,129,873	5,192,866	5,330,031	1,601,867	5,089,684	37,442,493	32,197,173
9	5,233,948	15,995,599	1,183,054	3,153,347	5,181,609	5,370,006	1,613,881	5,127,857	37,625,352	32,391,404
10	5,279,171	16,067,810	1,191,927	3,176,997	5,226,379	5,410,281	1,625,985	5,166,316	37,865,695	32,586,524
11	5,299,033	16,067,810	1,191,927	3,176,997	5,246,043	5,410,281	1,625,985	5,166,316	37,885,358	32,586,326
12	5,307,669	16,067,810	1,191,927	3,176,997	5,254,592	5,410,281	1,625,985	5,166,316	37,893,908	32,586,239
13	5,303,523	16,067,810	1,191,927	3,176,997	5,250,487	5,410,281	1,625,985	5,166,316	37,889,803	32,586,281
14	5,291,108	16,067,810	1,191,927	3,176,997	5,238,197	5,410,281	1,625,985	5,166,316	37,877,513	32,586,405
15	5,296,544	16,067,810	1,191,927	3,176,997	5,243,578	5,410,281	1,625,985	5,166,316	37,882,894	32,586,350
16	5,295,364	16,067,810	1,191,927	3,176,997	5,242,410	5,410,281	1,625,985	5,166,316	37,881,726	32,586,362
17	5,290,798	16,067,810	1,191,927	3,176,997	5,237,890	5,410,281	1,625,985	5,166,316	37,877,206	32,586,408
18	5,322,391	16,067,810	1,191,927	3,176,997	5,269,167	5,410,281	1,625,985	5,166,316	37,908,483	32,586,092
19	5,342,093	16,067,810	1,191,927	3,176,997	5,288,672	5,410,281	1,625,985	5,166,316	37,927,988	32,585,895
20	5,347,825	16,067,810	1,191,927	3,176,997	5,294,347	5,410,281	1,625,985	5,166,316	37,933,663	32,585,838
<b>NPV</b>	<b>120,175,457</b>	<b>172,513,680</b>	<b>12,223,505</b>	<b>32,580,893</b>	<b>118,973,702</b>	<b>55,483,768</b>	<b>16,674,876</b>	<b>52,981,847</b>	<b>461,432,271</b>	<b>341,256,815</b>
									Net benefit per member	29,065
									Benefit cost ratio	3.84



Table B6.2: Operating costs for broadband adoption in the Whitewater REMC service area over 20 years (current \$USD)

Year	Fixed	Labor	Subscribers	Revenue	Tax	New Sub.	Billing	Churn	Bad debt	Marketing	Access Fee	Total
1	659,560	834,370	1,702	1,225,760	17,161	20,429	13,279	13,620	12,258	452,230	320,349	2,343,255
2	877,431	1,398,210	4,426	3,186,977	44,618	32,687	34,526	35,411	31,870	293,525	1,099,596	3,847,873
3	903,819	1,531,102	6,810	4,903,042	68,643	28,601	53,116	54,478	49,030	176,115	1,816,373	4,681,278
4	884,732	1,611,786	6,861	4,939,814	69,157	613	53,515	54,887	49,398	118,291	2,224,083	5,066,462
5	919,278	1,702,912	6,912	4,976,863	69,676	617	53,916	55,298	49,769	119,178	2,227,837	5,198,482
6	902,991	1,702,912	6,964	5,014,189	70,199	622	54,320	55,713	50,142	90,054	2,231,593	5,158,546
7	906,146	1,702,912	7,016	5,051,796	70,725	627	54,728	56,131	50,518	90,729	2,228,754	5,161,270
8	933,429	1,765,561	7,069	5,089,684	71,256	631	55,138	56,552	50,897	91,410	2,220,446	5,245,319
9	925,608	1,765,561	7,122	5,127,857	71,790	636	55,552	56,976	51,279	92,095	2,214,451	5,233,948
10	919,040	1,765,561	7,175	5,166,316	72,328	641	55,968	57,404	51,663	92,786	2,263,779	5,279,171
11	921,748	1,765,561	7,175	5,166,316	72,328	0	55,968	57,404	51,663	92,786	2,281,574	5,299,033
12	923,209	1,765,561	7,175	5,166,316	72,328	0	55,968	57,404	51,663	92,786	2,288,750	5,307,669
13	926,023	1,765,561	7,175	5,166,316	72,328	0	55,968	57,404	51,663	92,786	2,281,790	5,303,523
14	928,891	1,765,561	7,175	5,166,316	72,328	0	55,968	57,404	51,663	92,786	2,266,506	5,291,108
15	931,816	1,765,561	7,175	5,166,316	72,328	0	55,968	57,404	51,663	92,786	2,269,017	5,296,544
16	936,233	1,765,561	7,175	5,166,316	72,328	0	55,968	57,404	51,663	92,786	2,263,420	5,295,364
17	939,273	1,765,561	7,175	5,166,316	72,328	0	55,968	57,404	51,663	92,786	2,255,814	5,290,798
18	946,470	1,765,561	7,175	5,166,316	72,328	0	55,968	57,404	51,663	92,786	2,280,211	5,322,391
19	947,730	1,765,561	7,175	5,166,316	72,328	0	55,968	57,404	51,663	92,786	2,298,652	5,342,093
20	950,951	1,765,561	7,175	5,166,316	72,328	0	55,968	57,404	51,663	92,786	2,301,163	5,347,825



Table B6.3: Telemedicine benefits over 20 years (current \$USD) in Whitewater REMC

Year	Primary Savings	Specialist	Transport	Missed Work	Pharmacy	Imaging	Web Consult	Urgent	Emergency	Total
1	275,796	6,367,400	8,899	59,890	251,962	51,073	61,288	260,474	1,332,138	8,668,920
2	717,070	6,367,400	23,136	155,714	655,101	132,791	159,349	677,233	3,463,558	12,351,352
3	1,103,184	6,367,400	35,594	239,561	1,007,847	204,293	245,152	1,041,896	5,328,551	15,573,479
4	1,111,458	6,367,400	35,861	241,357	1,015,406	205,826	246,991	1,049,711	5,368,515	15,642,525
5	1,119,794	6,367,400	36,130	243,167	1,023,022	207,369	248,843	1,057,583	5,408,779	15,712,088
6	1,128,193	6,367,400	36,401	244,991	1,030,695	208,925	250,709	1,065,515	5,449,345	15,782,173
7	1,136,654	6,367,400	36,674	246,829	1,038,425	210,491	252,590	1,073,507	5,490,215	15,852,784
8	1,145,179	6,367,400	36,949	248,680	1,046,213	212,070	254,484	1,081,558	5,531,391	15,923,925
9	1,153,768	6,367,400	37,226	250,545	1,054,059	213,661	256,393	1,089,670	5,572,877	15,995,599
10	1,162,421	6,367,400	37,506	252,424	1,061,965	215,263	258,316	1,097,842	5,614,673	16,067,810
11	1,162,421	6,367,400	37,506	252,424	1,061,965	215,263	258,316	1,097,842	5,614,673	16,067,810
12	1,162,421	6,367,400	37,506	252,424	1,061,965	215,263	258,316	1,097,842	5,614,673	16,067,810
13	1,162,421	6,367,400	37,506	252,424	1,061,965	215,263	258,316	1,097,842	5,614,673	16,067,810
14	1,162,421	6,367,400	37,506	252,424	1,061,965	215,263	258,316	1,097,842	5,614,673	16,067,810
15	1,162,421	6,367,400	37,506	252,424	1,061,965	215,263	258,316	1,097,842	5,614,673	16,067,810
16	1,162,421	6,367,400	37,506	252,424	1,061,965	215,263	258,316	1,097,842	5,614,673	16,067,810
17	1,162,421	6,367,400	37,506	252,424	1,061,965	215,263	258,316	1,097,842	5,614,673	16,067,810
18	1,162,421	6,367,400	37,506	252,424	1,061,965	215,263	258,316	1,097,842	5,614,673	16,067,810
19	1,162,421	6,367,400	37,506	252,424	1,061,965	215,263	258,316	1,097,842	5,614,673	16,067,810
20	1,162,421	6,367,400	37,506	252,424	1,061,965	215,263	258,316	1,097,842	5,614,673	16,067,810
<b>NPV</b>	<b>11,920,916</b>	<b>73,033,576</b>	<b>384,630</b>	<b>2,588,671</b>	<b>10,890,713</b>	<b>2,207,577</b>	<b>2,649,092</b>	<b>11,258,643</b>	<b>57,579,862</b>	<b>172,513,680</b>

Table B7: Summary Table of Metrics for all seven Cooperatives

Cooperative	NPV	Ann. NPV	B/C	Members	NPV/member	B/member cost	Rev/cost
Tipmont	560,280,195	48,847,781	3.96	22,631	24,757	4.49	0.54
Henry County	190,129,578	16,576,363	3.24	8,500	22,368	3.96	0.45
Jackson County	582,505,581	50,785,491	4.09	24,203	24,067	4.33	0.58
Marshall County	165,610,509	14,438,679	3.03	7,249	22,846	4.06	0.40
Noble County	246,440,421	21,485,799	3.47	10,646	23,149	4.13	0.48
Orange County	166,377,353	14,505,536	2.97	7,756	21,451	3.75	0.41
Whitewater	341,256,815	29,752,324	3.84	11,741	29,065	5.44	0.44

**Table C1: Tax Revenue and Cost Savings for Federal and State of Indiana Government, Year three**

Cooperative	Federal Income Tax	Federal Medicare Savings	Federal Medicaid Savings, Telemedicine	Federal Medicaid Savings, Fewer Recipients	Indiana Sales Tax, Income Growth	Indiana Sales Tax, Telemedicine Savings	Indiana Income Tax	Indiana Medicaid Savings, Telemedicine	Indiana Medicaid Savings, Fewer Recipients
Henry	955,898	2,063,782	1,321,200	168,822	243,893	27,518	183,235	328,979	42,037
Jackson	2,385,446	5,291,929	3,300,600	369,989	592,263	130,480	446,078	821,850	92,127
Marshall	949,313	1,520,447	896,333	156,657	229,618	22,906	171,249	223,187	39,008
Noble	1,206,690	2,346,054	1,415,139	202,421	276,887	34,163	226,748	352,370	50,403
Orange	870,120	1,768,307	1,223,911	157,242	219,831	23,522	169,985	304,754	39,153
Tipmont	3,421,973	3,881,259	2,859,304	447,952	526,541	62,184	528,425	711,967	111,540
Whitewater	1,221,289	4,574,166	2,766,633	199,762	324,636	60,643	235,041	688,892	49,741

**Table C2: Summary of State and Federal Revenue and Cost Savings by Cooperative, Year three**

Cooperative	Year 3 Net Benefit	Total Federal	Total State of Indiana	Total, Federal and State
Henry	17,602,347	4,509,702	825,662	5,335,364
Jackson	53,840,546	11,347,964	2,082,798	13,430,762
Marshall	15,347,027	3,522,749	685,967	4,208,716
Noble	22,777,888	5,170,303	940,571	6,110,874
Orange	15,416,517	4,019,580	757,246	4,776,826
Tipmont	51,638,797	10,610,488	1,940,658	12,551,146
Whitewater	31,253,692	8,761,850	1,358,954	10,120,804
<b>Total REMC</b>	<b>208,035,086</b>	<b>47,942,638</b>	<b>8,591,854</b>	<b>56,534,492</b>

## ■ ■ **References**

1. Grant, A. and W.E. Tyner, Benefit Cost Analysis for Implementation of Rural Broadband in the Tipmont Cooperative in Indiana, Purdue Center for Regional Development, Editor. 2018, Purdue University: West Lafayette, IN.
2. Whitacre, B.E., Estimating the economic impact of telemedicine in a rural community. *Agricultural and resource economics review*, 2011. 40(2): p. 172.
3. Ong, D. and M. Jambulingam, Reducing Employee Learning and Development Costs: the Use of Massive Open Online Courses (MOOC). *Development and Learning in Organizations: An International Journal*, 2016. 30(5): p. 18-21.
4. Whitacre, B., R. Gallardo, and S. Strover, Broadband's Contribution to Economic Growth in Rural Areas: Moving Towards a Causal Relationship. *Telecommunications Policy*, 2014. 38(11): p. 1011-1023.
5. Whitacre, B., R. Gallardo, and S. Strover, Does Rural Broadband Impact Jobs and Income? Evidence from Spatial and First-differenced Regressions. *The Annals of Regional Science*, 2014. 53(3): p. 649-670.
6. Kim, Y. and P.F. Orazem, Broadband Internet and New Firm Location Decisions in Rural Areas. *American Journal of Agricultural Economics*, 2017: p. aaw082.
7. Kolko, J., Broadband and Local Growth. *Journal of Urban Economics*, 2010. 1(1).
8. Sosa, D., Early Evidence Suggests Gigabit Broadband Drives GDP. Analysis Group, 2014.
9. Lobo, B.J., A. Novobilski, and S. Ghosh, The Economic Impact of Broadband: Estimates From A Regional Input-Output Model. *The Journal of Applied Business Research*, 2008. 24(2): p. 103-114.
10. Audretsch, D.B., D. Heger, and T. Veith, Infrastructure and Entrepreneurship. *Small Business Economics*, 2015. 44(2): p. 219-230.
11. Rembert, M., B. Feng, and M. Partridge, Connecting the Dots of Ohio's Broadband Policy, in Swank Program in Rural-Urban Policy. 2017, The Ohio State University.
12. UK Government. Government Digital Inclusion Strategy. 2014; Available from: <https://www.gov.uk/government/publications/government-digital-inclusion-strategy/government-digital-inclusion-strategy#contents>.
13. Kandilov, A.M., et al., The Impact of Broadband on US Agriculture: An Evaluation of the USDA Broadband Loan Program. *Applied Economic Perspectives and Policy*, 2017. 39(4): p. 635-661.
14. Internal Revenue Service, Individual Income Tax Returns: Selected Income and Tax Items by State, County, and Size of Adjusted Gross Income, Tax Year 2015. <https://www.irs.gov/statistics/soi-tax-stats-county-data-2015>.
15. Internal Revenue Service, Individual Income Tax Returns: Selected Income and Tax Items by State, ZIP Code, and Size of Adjusted Gross Income, Tax Year 2015. <https://www.irs.gov/statistics/soi-tax-stats-individual-income-tax-statistics-2015-zip-code-data-soi>.

16. Joint Committee on Taxation, Distributional Effects of the Conference Agreement for H.R.1, the "Tax Cuts and Jobs Act." December 18, 2017. <https://www.jct.gov/publications.html?func=startdown&id=5054>.
17. Indiana Legislative Services Agency, Indiana Handbook of Taxes, Revenues and Appropriations. Indiana LSA, Office of Fiscal and Management Analysis, Fiscal Year 2017.
18. U.S. Bureau of Labor Statistics, Consumer Expenditure Surveys, Cross-Tabulated Tables, Age of Reference Person by Income Before Taxes. <https://www.bls.gov/cex/csxresearchtables.htm#crosstab>.
19. United States Census Bureau, Annual County Resident Population Estimates by Age, Sex, Race, and Hispanic Origin: April 1, 2010 to July 1, 2016. <https://www.census.gov/data/datasets/2016/demo/popest/counties-detail.html>.
20. Indiana Family and Social Services Administration, Enrollment by County and Health Program. April 2018. <https://www.in.gov/fssa/ompp/4881.htm>.
21. Centers for Medicare and Medicaid Services, State/County Table – All Beneficiaries. [https://www.cms.gov/Research-Statistics-Data-andSystems/Statistics-Trends-and-Reports/Medicare-GeographicVariation/GV\\_PUF.html](https://www.cms.gov/Research-Statistics-Data-andSystems/Statistics-Trends-and-Reports/Medicare-GeographicVariation/GV_PUF.html).





**Center for Regional Development**  
Advancing Collaboration : Energizing Regions

PCRD seeks to pioneer new ideas and strategies that contribute to regional collaboration, innovation and prosperity. Founded in 2005, the Center partners with public, private, nonprofit and philanthropic organizations to identify and enhance the key drivers of innovation in regions across Indiana, the U.S. and beyond. These drivers include a vibrant and inclusive civic leadership, a commitment to collaboration, and the application of advanced data support systems to promote sound decision-making and the pursuit of economic development investments that build on the competitive assets of regions.



**Purdue Schowe House**

1341 Northwestern Avenue  
West Lafayette, IN 47906



**Lionel J. Beaulieu**

[ljb@purdue.edu](mailto:ljb@purdue.edu)



**765-494-7273**

Ask for Bo Beaulieu