



Affordable Electricity: Rural America's Economic Lifeline

Summary

Affordable electricity is essential to economic growth in rural America. Public policies, programs and other factors that increase the price of electricity even a small amount impair economic growth and job creation. This study measures the impact of a 10% and 25% electricity price increase in terms of lost jobs and gross domestic product (GDP). It examines the entire U.S. economy and the area served by America's not-for-profit electric cooperatives, labeled as Co-op Nation and vicinity.

Electric cooperatives serve 42 million Americans in 47 states. Electric co-ops are owned by the members that they serve, and own and maintain nearly 75% of the nation's electric distribution lines. The economic health of electric cooperative service areas are tightly integrated with their surrounding towns and communities. The economy of Co-op Nation and vicinity accounts for this interrelationship by including all U.S. counties where at least 10% of households are members of electric co-ops.

In 2012, businesses and industries in Co-op Nation and vicinity required 34% more electricity (in terms of expenditures on electricity per dollar of output) than the businesses and industries in the rest of the U.S. This is due to a higher concentration of energy-intensive businesses being located in rural areas with affordable electricity. These industries include agriculture and manufacturing, among others and have a greater sensitivity to electricity price increases than the more service-based economies found in more densely populated areas.

A 10% increase in electricity prices over the 2020 to 2040 period results in:

- A non-cumulative average job loss of 882,000 nationwide that peaks at 1.2 million by 2021
 - Of that, a non-cumulative average job loss of 360,000 in areas served by electric cooperatives that peaks at 499,000 by 2021
- A cumulative loss in national GDP of \$2.8 trillion

A 25% increase in electricity prices over the 2020 to 2040 period results in:

- A non-cumulative average job loss of 1.5 million nationwide that peaks at 2.2 million by 2021
 - Of that, a non-cumulative average job loss of 614,000 in areas served by electric cooperatives that peaks at 893,000 by 2021
- A cumulative loss in national GDP of \$5.4 trillion

The study also reveals a substantial decline in the average per capita real disposable personal income (RDPI) in areas served by Co-op Nation and vicinity. This decline of \$479 and \$1028 in the 10% and 25% electricity price increase scenarios, respectively hits a population already earning a median income that is less than the national average, further disadvantaging them. Importantly, the loss in co-op areas exceeds the average loss in per capita RDPI measured across the rest of U.S. (\$323 and \$681 in the 10% and 25% price increase scenarios, respectively).

Electricity price increases negatively impact the nation's economy, particularly areas served by electric cooperatives. Higher electricity prices hit American families from both sides as they pay more out of their pocket to keep the lights on, while simultaneously, enduring higher prices for goods and services produced with electricity, job losses, and less money in the family budget.

**As noted above, the job loss numbers in this study are averages that occur over the 2020 to 2040 period and are not cumulative.*

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Affordable Electricity is Essential to Economic Growth

Historically electricity sales growth has been closely correlated with growth in the nation's gross domestic product (GDP). Some have noted in recent years that electricity growth has stagnated even as the economy continues to expand, suggesting that electricity use is less important to U.S. GDP growth today than in the past. Quite the reverse, affordable electricity is essential to providing the useful work that drives the economy and jobs. When electricity prices rise, electricity consumption falls, causing useful work, employment, and economic growth to decline.

Handicapping Electricity Use

Government policies and programs can handicap the full potential of affordable electricity by putting upward pressure on electricity rates, thereby foreclosing opportunities for economic growth. Federal environmental regulations under the Clean Air Act often require electricity suppliers to undertake costly new investments and incur higher operating costs. Biased approaches to setting energy efficiency policy by both federal and state governments can impede the penetration of low cost, electric household appliances in favor of more costly, non-electric technologies. Many jurisdictions make the siting of electric transmission lines difficult, especially when crossing state lines or federal lands. This often leads to delays, longer routes, and more costly projects. Moreover, NIMBYism often leads to cancellations of new electricity generation, transmission and distribution projects which are designed to assure reliable and affordable electricity.

Examining the Impact of Higher Electricity Prices on Co-op Nation

The National Rural Electric Co-operative Association (NRECA) engaged Regional Economic Models, Inc. (REMI) to examine the impact of electricity price increases using a 2-region REMI PI⁺ model of the United States' economy and demographics.¹ REMI PI⁺ is a computerized model of subnational units of the United States with the 3,143 counties and county-equivalents as its fundamental building blocks of geography.² The two regions approximate the economic and physical space served by the rural electric co-operatives,³ called "Co-op Nation and vicinity" here, and the remainder of the United States not served by rural co-ops. This allows for the simulation of changing electricity prices across the two regions and measurement of the resulting economic impacts.

The service territories of the electric cooperatives that comprise Co-op Nation do not follow the borders of counties. PI⁺ is predominantly a county-level model in its ready configurations. NRECA and REMI

¹ Special thanks to Scott Nystrom of REMI for highlighting the critical role of electricity to the economy of rural America.

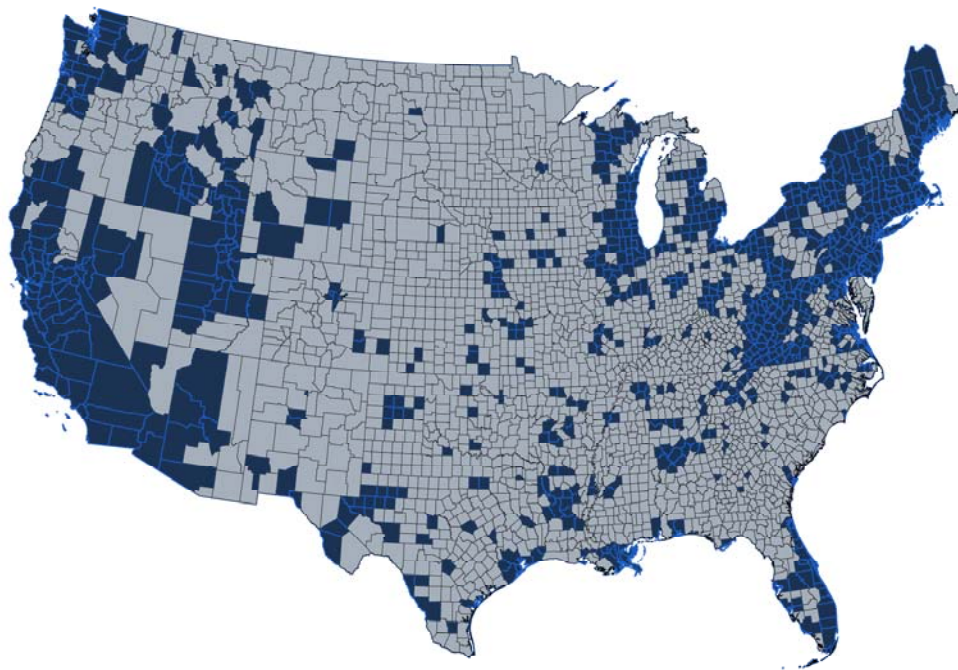
² The independent "city/counties" throughout the United States, political entities organized as cities and not officially part of a surrounding county, are *de facto* counties in the REMI model—such cities as Alexandria, Virginia or Baltimore, Maryland, for instance.

³ Electric cooperatives are: Private, independent, non-profit electric utilities; Owned by the customers they serve; Incorporated under the laws of the states in which they operate; Established to provide at-cost electric service; Governed by a board of directors elected from the membership which sets policies and procedures that are implemented by the co-op's management," <<http://www.nreca.co-op/about-electric-Co-operatives/co-op-facts-figures/>>.

adjusted for this based on the preponderance of households either in or out of Co-op Nation by county; the tipping point for “in” versus “out” was 10% of households in a given county. Any county with more than 10% of its households served by co-ops became part of Co-op Nation and vicinity. A 10% share indicates a strong enough co-op presence in a county to warrant its inclusion given the economic health of these counties is of significant importance to co-op member-consumers in their regions. These counties have an open and integrated economy between Co-op Nation and the rest of the United States, in which people often commute to nearby towns or cities and live, work, and spend freely between the two as a connected economy.

Figure 1 depicts the 2-region configuration between Co-op Nation and the rest of the nation at the heart of this study.⁴ The gray region includes Co-op Nation while the blue area surrounded by light blue borders includes the rest of the United States. Co-op Nation involves mostly rural counties in the Midwestern, Southern, and Western United States with less of a presence in California, around large cities like Chicago, and in the Northeast.

Figure 1 Co-op Nation (and Vicinity) and Rest of USA



⁴ The breakout for Hawaii is such that Kauai County is part of Co-op Nation while the other counties (with Hawaii, Honolulu, Maui, and Kalawao Counties) belong to the rest of United States region. Alaska is a special case where the whole state is a part of the rest of United States region owing to data limitations with its small, rural, outlying areas with little permanent economic activity.

This study also makes adjustments to reallocate jobs and business activity between the two regions with a finer geographical delineation. Using sub-county employment data by ZIP code, the county-level results by sector are adjusted to better reflect the industry mix in areas served by electric co-ops. For example, consider the case of a Midwestern metropolitan area with the city itself served by a municipal utility and the outlying areas, including many industrial parks and most agricultural operations, served by rural co-ops. One example is Topeka, Kansas in Shawnee County. The population of Topeka is 128,000 (or 72% of Shawnee County's 178,000). Topeka is only 60 square miles, however, and the county is 556 square miles (only 11% within the city). Co-ops serve most the area in Shawnee County outside of Topeka and industrial and agricultural output in the county but not in the city. Shawnee County is not part of "Co-op Nation" in the calculations because less than 10% of the households in the county receive their service through rural co-ops. Without this adjustment, activity ascribed to the rest of USA region not in Co-op Nation would be an overestimation. The ZIP code-level methodology adjusts for this by ascribing a percentage of the county-level results by sector in each region "back" into the other region; that is, it also adjusts activity in Co-op Nation into the area not served by rural co-ops, as well. This provides better refinement of the geographical coverage for the overall change in economic output on the rural/urban split in the model. Appendix 1 provides more information on this adjustment.

Characteristics of Co-op Nation and Vicinity and Rest of USA

The two regions divide the country into a "rural" and "urban" delineated by the relative size of the co-op presence within each group. Table 1 breaks out some key economic indicators and their shares between the two regions. Co-op Nation and vicinity contains around one-quarter of the United States' population and GDP and a disproportionate share of key industries such as manufacturing and agriculture.

Table 1 Economic Indicators from Two Region Model

Historical Data from 2012	Co-op Nation (and vicinity)	Rest of USA
Employment	47.5 million	132.1 million
GDP	\$3.8 trillion	\$13.4 trillion
Personal Income	\$3.6 trillion	\$10.7 trillion
Population	92 million	222 million
Real Income Per Capita	\$39,000 per year	\$48,000 per year
MFG Employment	4.0 million	8.6 million
Farm Employment	1.7 million	940,000

Historical Data from 2012	Co-op Nation (and vicinity)	Rest of USA
Employment	26%	74%
GDP	23%	77%
Personal Income	25%	75%
Population	29%	71%
Real Income Per Capita	81% of Rest of USA	-
MFG Employment	32%	68%
Farm Employment	64%	36%

Co-op Nation and Vicinity is more Electricity Intensive than the Rest of U.S.

The industry mixture in the Co-op Nation counties suggests the potential for greater sensitivity to fluctuations in electricity prices. This is because the industry make-up of Co-op Nation and vicinity requires more purchased electricity to produce goods and services than the composition of industry in the rest of the nation.

For 2012, the data in Table 2 shows electricity purchases as an input to the average dollar of output by region. Across all businesses and industries in 2012, those in Co-op Nation and vicinity required 34% more electricity (in terms of dollar expenditures) as an input than the businesses and industries in the rest of the U.S. The difference is not efficiency, climate, or any set of policies, but rather the calculation that Co-op Nation and vicinity has a higher concentration of enterprises that need more electricity inputs.

The second column of Table 2 identifies the percentage of consumer spending on electricity by region. It indicates that households in Co-op Nation and vicinity also tend to use more electricity than their urban counterparts. This is due to the prevalence of detached single unit homes, a disproportionate share of energy inefficient and difficult to upgrade manufactured housing, and a greater reliance on electric appliances due to lack of natural gas infrastructure. Most of these households are located in geographic regions requiring significant air conditioning requirements, a major driver of electricity demand. As a result, Co-op Nation's residential households' share of expenditures spent on electricity exceeds that of rest of U.S. (1.72% and 1.45% for Co-op Nation and rest of U.S., respectively).

Table 2 Co-op Nation and Vicinity More Electricity Intensive than the Rest of U.S. ⁵

Region	Electricity inputs as a share of output by region	Electricity as a percentage of consumer spending
Co-op Nation	0.81%	1.72%
Rest of United States	0.60%	1.45%

Simulation Methodology

REMI simulated both a 10% and 25% increase in electricity prices over the 2016 – 2040 period and measured the impacts from the baseline or business-as-usual forecast. All price changes begin in 2016 and phase in at a linear rate from 2016 before achieving the highest level of change in 2020. For instance, in the 10% case, the change in prices is +2% in 2016, +4% in 2017, and continuing to reach +10% by 2020. The phrase “from against the baseline” bears some expansion here for how these electricity price changes work within the model. The change in electricity prices here is not a compounding change in the price—it is a one-time, “scalar” adjustment against the baseline prices. This allows a view of how the economy might look different if electricity were a different price for residential

⁵ The electricity share of output weighted by the output of each industry in the two regions, where large industries with a distinct need for electricity inputs (such as manufacturing in Co-op Nation or some of the petroleum refining in the rest of the country) count heavily while small industries with diminutive electricity input (such as museums in the rest of the United States) count for relatively little.

and business consumers, sustained over the long-term and with long-term economic adjustments, divided between Co-op Nation and vicinity, and the rest of the United States.

The model allocates most dollars from the assumed higher electricity prices to output and profit margin for that industry as well as higher prices charged to electricity producers by their suppliers (such as the railroads delivering coal to plants or producers extracting natural gas from wells and moving it to the point of consumption through the pipeline network). The excess revenues not automatically allocated in REMI PI⁺ were directed to scientific research and development, which is a sub-industry of professional and technical services. This cost becomes “sunk.” It creates jobs and output much in the way as any other industry (such as manufacturing or other services), but it does not lead to any long-term breakthroughs in technology or productivity in the system on its own. It is just another industry in the transactional sense.

Employment

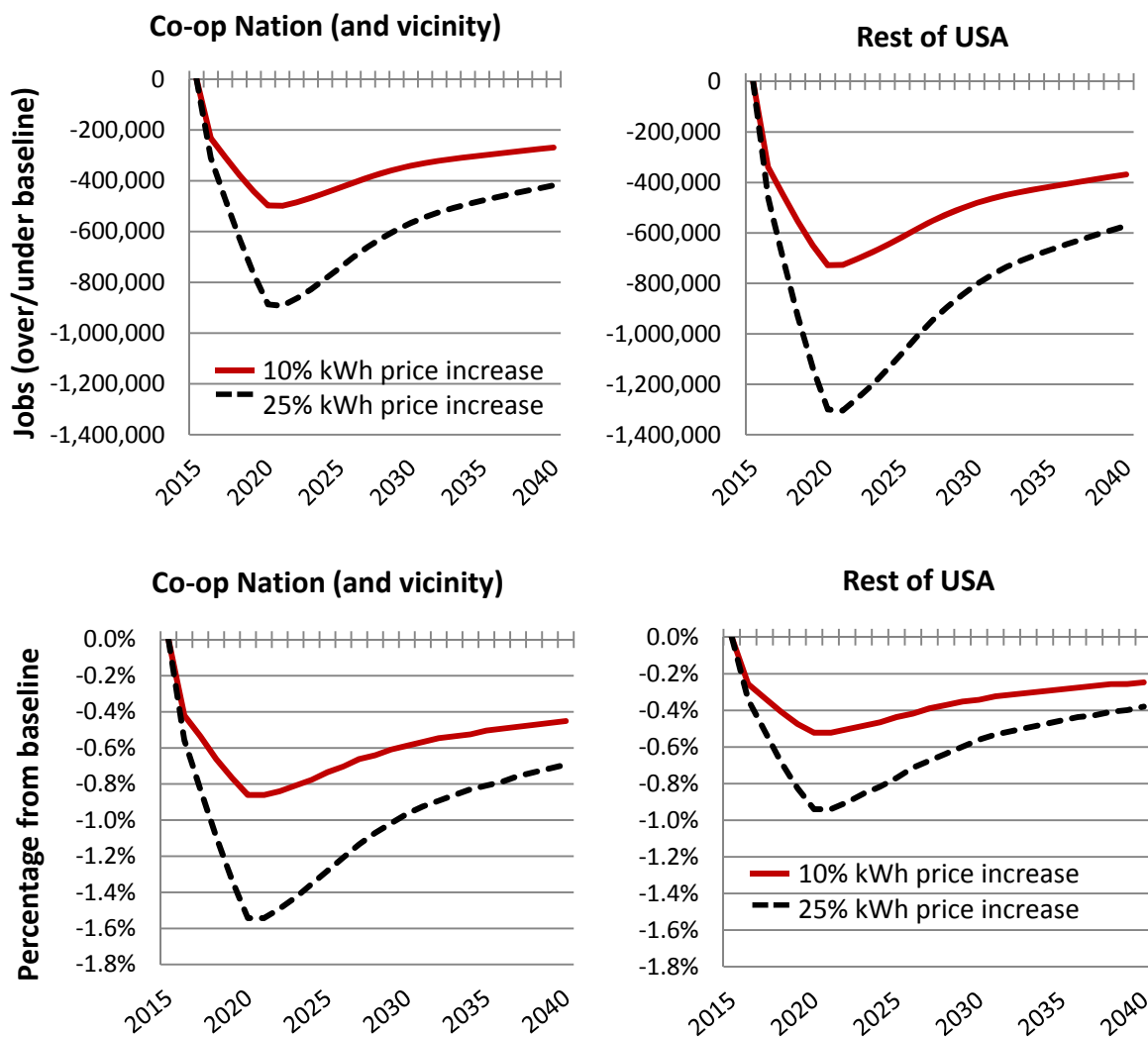
The simulation results show that electricity price increases significantly harm the U.S. economy. In terms of employment losses and GDP losses, the larger absolute shock takes place in the rest of the United States, though the proportion of the electricity price shock is much larger in Co-op Nation and vicinity. Their relatively small populations and electricity-intensive industry mixture contributes to their larger impacts compared to their urban counterparts.

Figure 2 shows both the absolute change in jobs and the relative percentage change resulting from a 10% and a 25% increase in electricity prices. The change in employment is measured against a baseline projection that assumes business-as-usual, i.e., no electricity price changes. The average annual number of jobs lost over the 2020-2040 period in the U.S. ranges from about 880,000 to 1.5 million in the 10% and 25% price increase cases, respectively. Peak year job losses total 1.2 million and 2.2 million, respectively. Job losses in Co-op Nation and vicinity average 360,000 and 614,000 over the same period with peak losses of 499,000 and 893,000 jobs in the 10% and 25% price increase simulations, respectively. In contrast, job losses in the rest of the U.S. average 522,000 and 875,000 in the 10% and 25% price increase cases, respectively, over the 2020 – 2040 period.

In relative terms, as depicted in the bottom panels of Figure 2, the losses in Co-op Nation and vicinity are greater than in the rest of the USA. On average, over the 2020-2040 period, employment in Co-op Nation declines 0.63% and 1.05% in the 10% and 25% electricity price increase cases, respectively. In contrast, employment in the rest of the USA declines by 0.36% and 0.62%, respectively.

The effect of electricity price increases is to cause employment declines across all industry sectors of Co-op Nation and vicinity as shown in Figures 2.1 and 2.3 for the 10% and 25% cases, respectively. State and local government, construction, and retail trade see the most concentrated job losses from higher electricity costs (and all for their own reasons), while smaller sectors have impacts in-kind with the size of the industry and their increase in costs. Farming, for instance, has a negative impact but starts with a smaller baseline of jobs to lose.

Figure 2 Employment (absolute change and percentage change)



State and local government, in particular, has a pinch in its budgets from higher electricity usage costs. This study assumes state and local governments maintain balanced budgets. Electricity price increases are offset by reductions in other areas of state and local government budgets, including employment.⁶ State and local governments see employment levels decrease in the scenarios. The rest of the industries have a similar effect from the higher prices.

The rest of the United States shows a similar pattern. It does have one benefit in one industry set, however, with professional services and its uptake of the higher dollars from electricity prices. One

⁶ Although not modeled here, an alternative assumption of tax increases to cover the higher costs of electricity would be expected to further increase the cost of goods and services leading to an additional incremental decline in the demand for goods and services and, ultimately, additional declines in employment.

Figure 2.1 Change in Jobs By Sector (10% increase, Co-op Nation, ann. avg. 2016-2040)

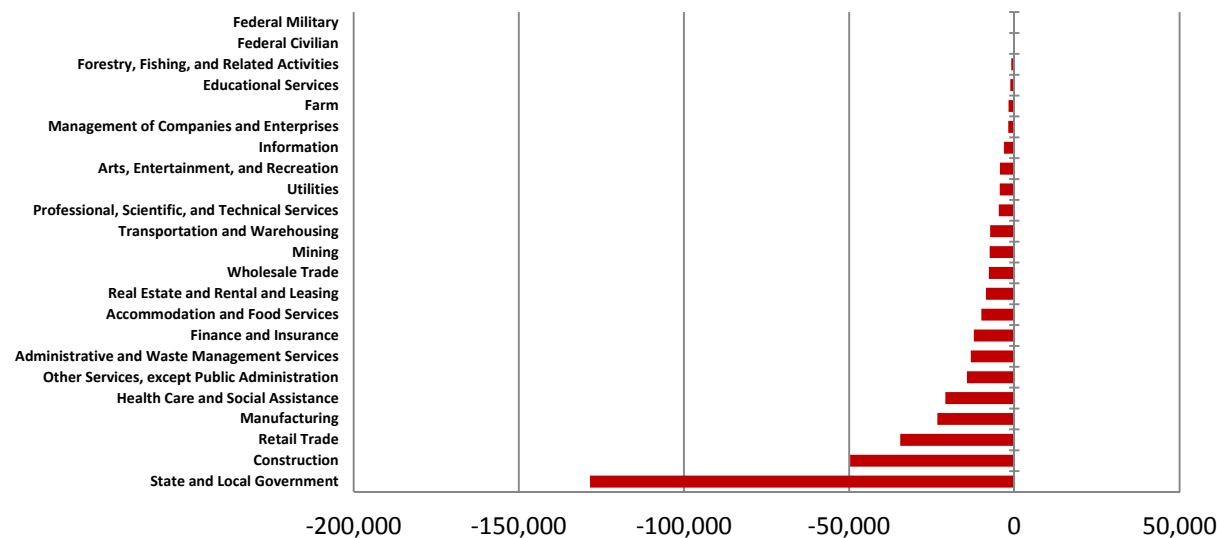


Figure 2.2 Change in Jobs By Sector (10% increase, Rest of USA, ann. avg. 2016-2040)

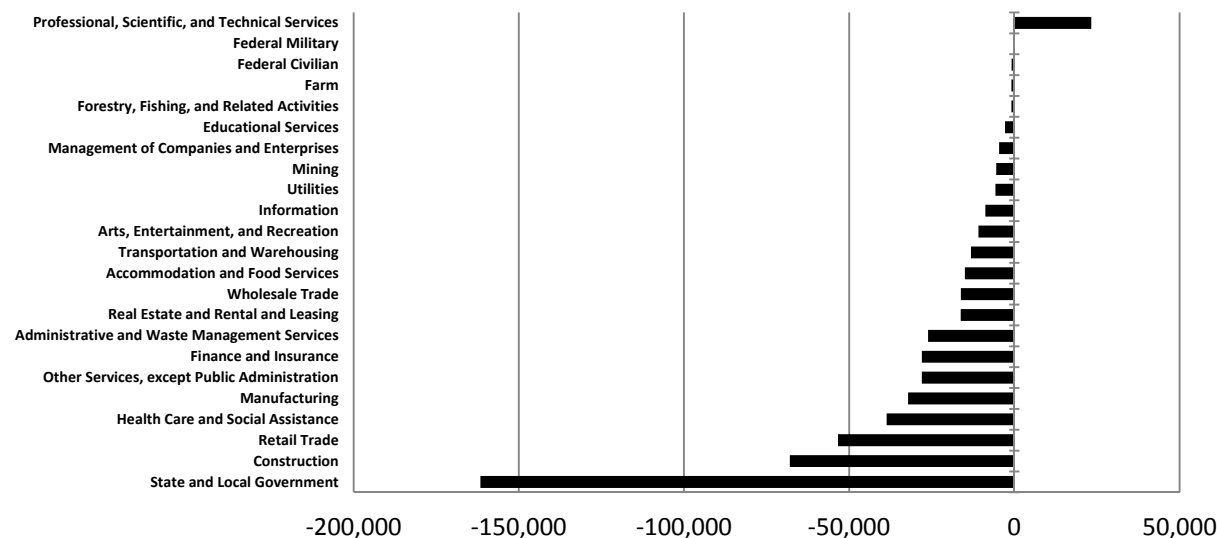


Figure 2.3 Change in Jobs By Sector (25% increase, Co-op Nation, ann. avg 2016-2040)

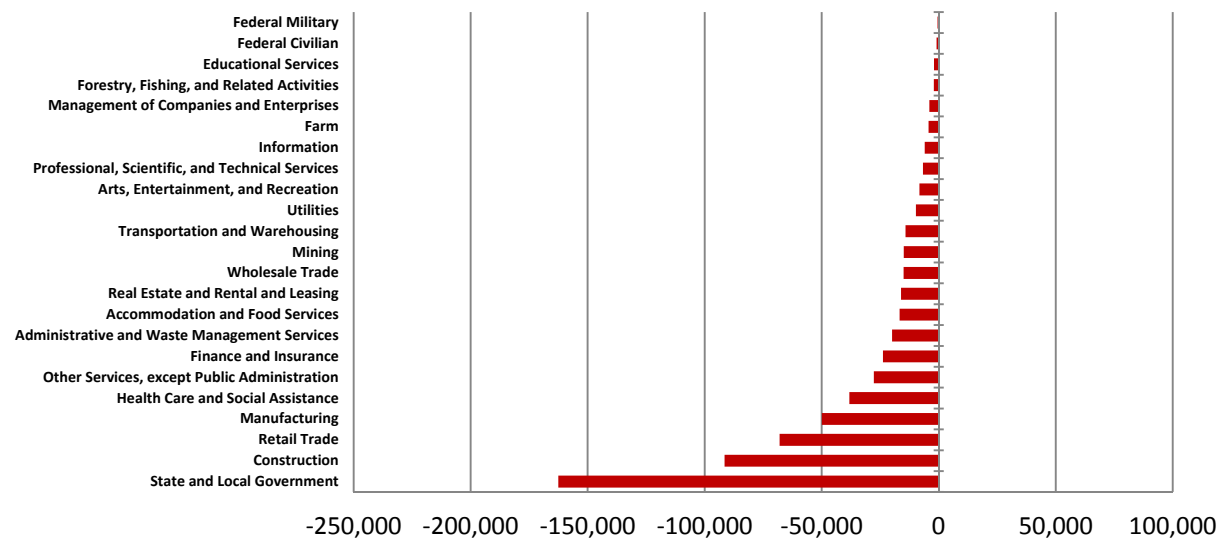
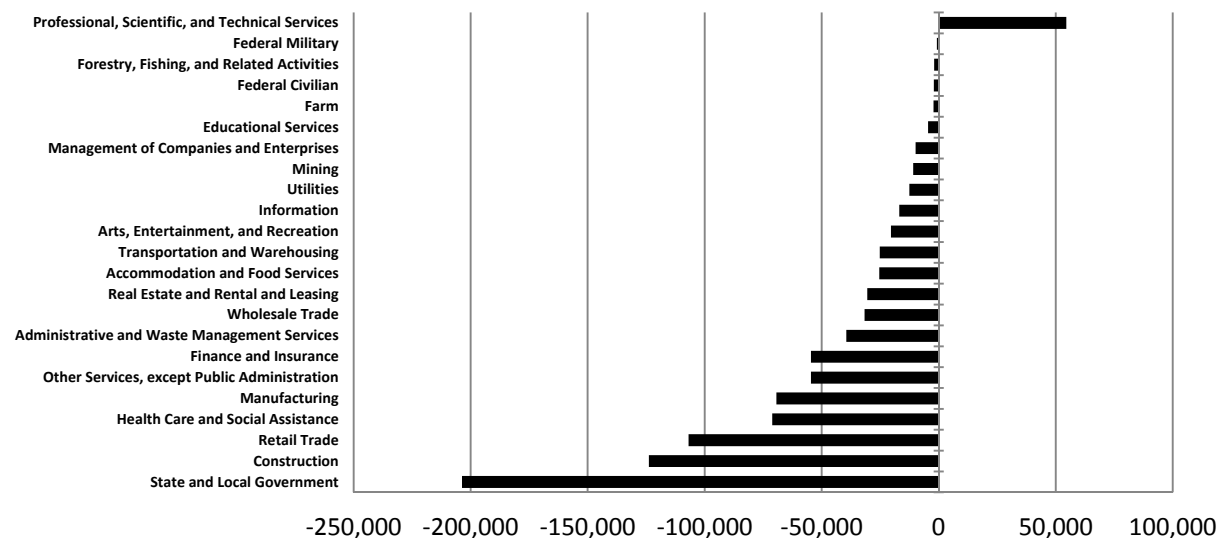


Figure 2.4 Change in Jobs By Sector (25% increase, Rest of USA, ann. avg. 2016-2040)



should note the REMI model does not account for any productivity benefits of long-term R&D spending. The dollars to scientific research are “sunk” as they would be in any other industry without a long-term bonus to underlying costs.

Gross Domestic Product

The impact of electricity price increases on gross domestic product (GDP) or output is similar to the impact on employment. GDP reports the total change in the value of business activity in an area over time. Electricity price increases in Co-op Nation have less of an absolute impact but more of an impact in terms of the proportional change in GDP.

Higher electricity prices reduce the overall level of economic activity in both regions. The electricity- and capital-intensive industries found more in rural America (counting but not limited to agriculture and manufacturing) have a greater sensitivity to a change in electricity prices than the more service-based economies found in the larger cities represented in the “rest of USA” region. Although Co-op Nation has less of an impact in terms of the total dollar flows, its smaller economy and local/state tax bases will feel these changes to a larger degree.

Figure 3 summarizes the GDP impacts for Co-op Nation and vicinity and the rest of the United States. The change in GDP is measured against a baseline projection that assumes business-as-usual, i.e., no electricity price changes. The top panels present the absolute losses in GDP due to electricity price increases. The shape of the curves here are flatter than those in the top panels of Figure 2 because much of the change in GDP relates to the change in real income for consumers and competitiveness for business. Given these changes ratchet up to 2020 and hold thereafter, the change in electricity prices permanently affects American economic output. Employment recovers, however, as lower employment pushes down wages, and increases hiring, thus improving jobs, and returning towards full employment.

Total U.S. GDP losses average \$135 billion to \$257 billion annually over the 2020-2040 period in the 10% and 25% electricity price increase simulations, respectively. The cumulative loss in U.S. GDP over the 2020-2040 period is \$2.8 trillion and \$5.4 trillion, respectively. Annual GDP declines in Co-op Nation average \$48 billion and \$92 billion in the 10% and 25% cases, respectively. Cumulative GDP losses in Co-op Nation and vicinity total \$1 trillion and \$1.9 trillion over the 2020 – 2040 period, respectively. For the rest of the USA, annual GDP decreases average \$86 and \$165 billion and total \$1.8 and \$3.5 trillion over the 2020-2040 period in the 10% and 25% electricity price increase cases, respectively.

Co-op Nation and vicinity, however, suffers higher relative impacts than the rest of the U.S. The percentage a loss in GDP in the 10% electricity price increase case is 0.73% in Co-op Nation and 0.46% in the rest of the U.S. A 25% electricity price increase leads to a loss of GDP of 1.39% in Co-op Nation and vicinity compared to a 0.89% decline in the GDP of the rest of the U.S.

Figures 3.1 – 3.4 show the GDP impacts from electricity price increases on a sector-by-sector basis. A 10% increase generally drives business activity out of Co-op Nation and into the rest of the world in the model. Some of the dollars do remain in the rest of the USA, in Figure 3.4, within the professional services industry, though most move out of the United States from a decrease in competitiveness. The results in the 25% increase scenarios post a similar result.

Sectors in Co-op Nation and vicinity with concentrated losses to their GDP contribution include state and local government, the construction sector, retail trade, manufacturing, and healthcare. Many of the sectors with the smaller impact in absolute terms above tend to be smaller sectors of the economy. The results for the rest of the United States are similar, though exaggerated with the larger economy in the remainder of the nation, and the slight offset for professional services. Real estate makes a large appearance here given it is much like manufacturing—a large output industry that is capital intensive and requires only diminutive inputs in terms of labor.

Figure 3 Gross Domestic Product (absolute and percentage change)

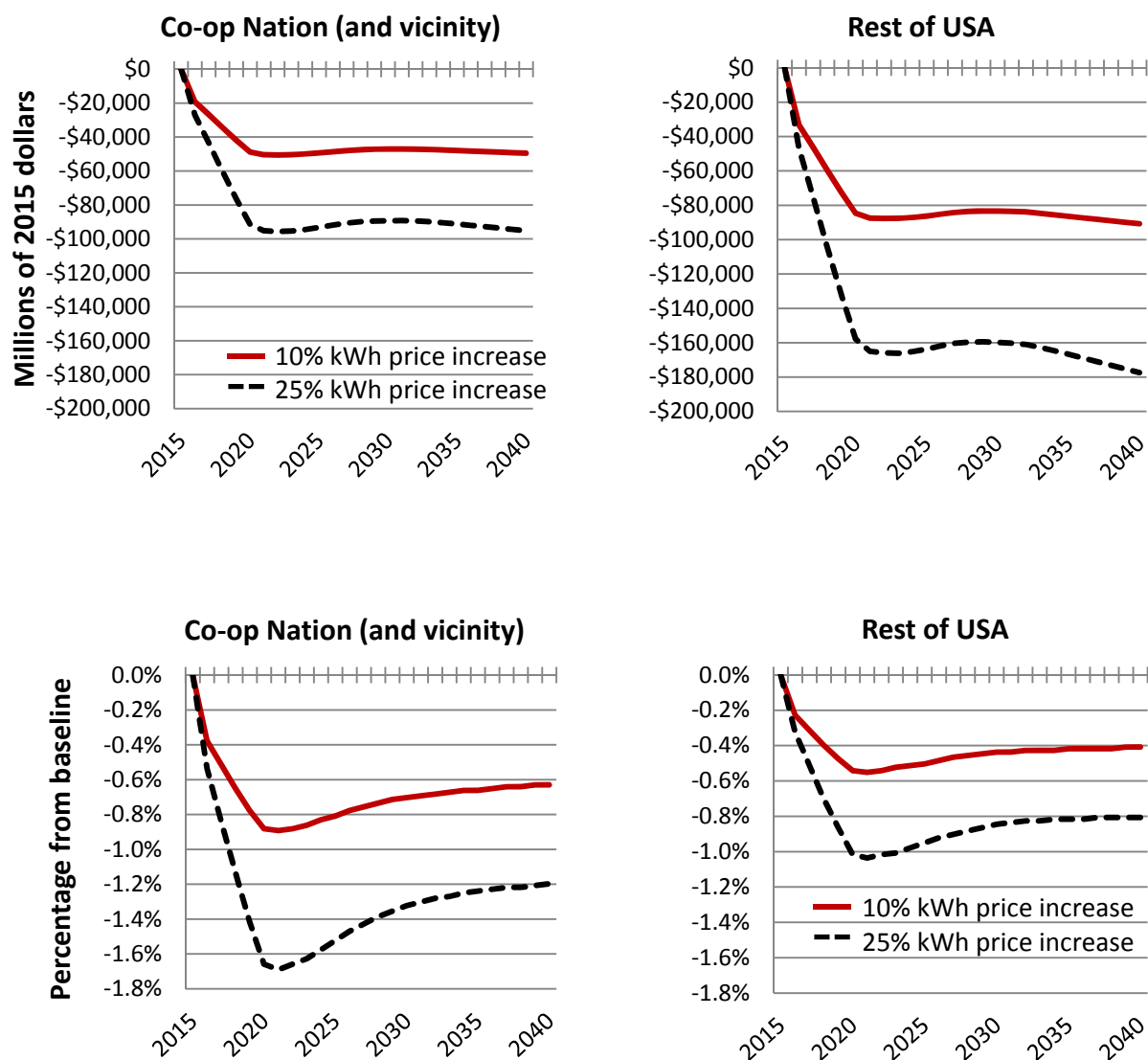


Figure 3.1 Change in GDP By Sector (10% increase, Co-op Nation, ann. avg. 2016-2040)
(millions of 2015\$)

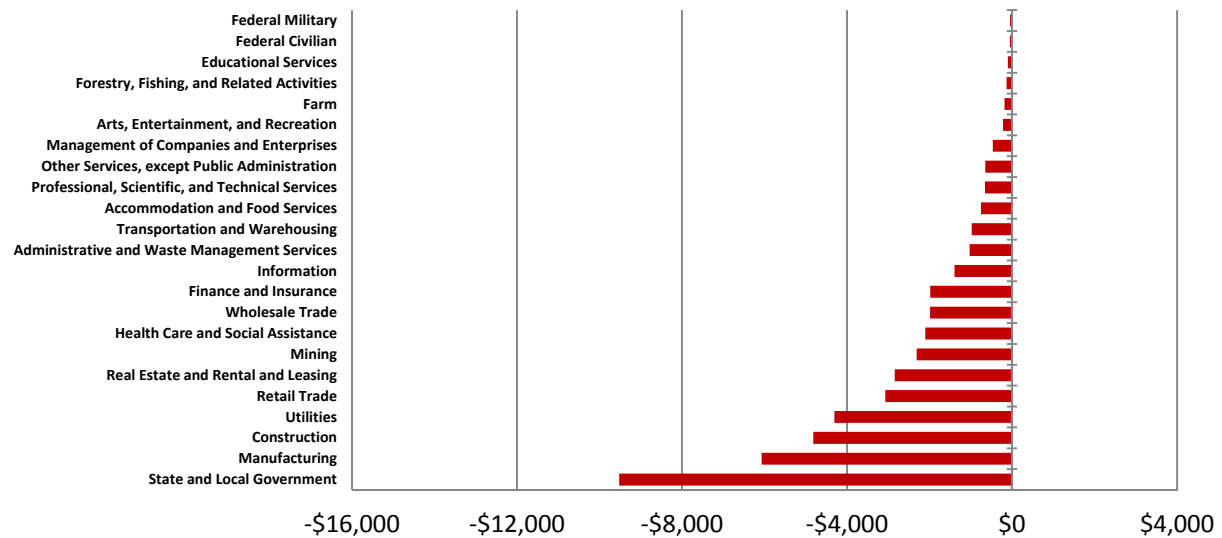


Figure 3.2 Change in GDP By Sector (10% increase, Rest of USA, ann. avg. 2016-2040)
(millions of 2015\$)

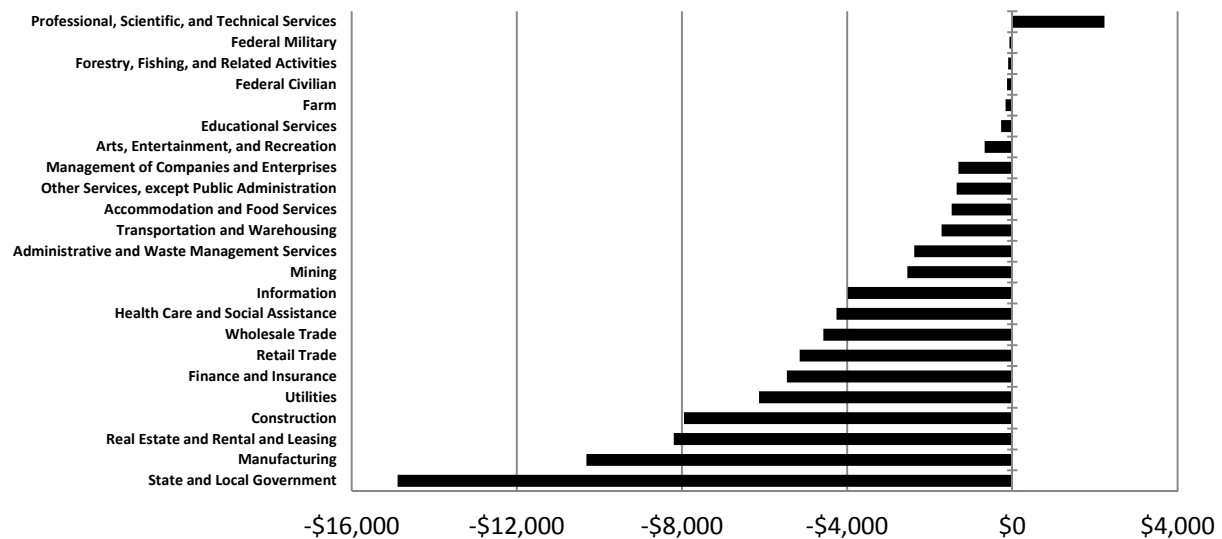


Figure 3.3 Change By Sector (25% increase, Co-op Nation, ann. avg. 2016-2040)
(millions of 2015\$)

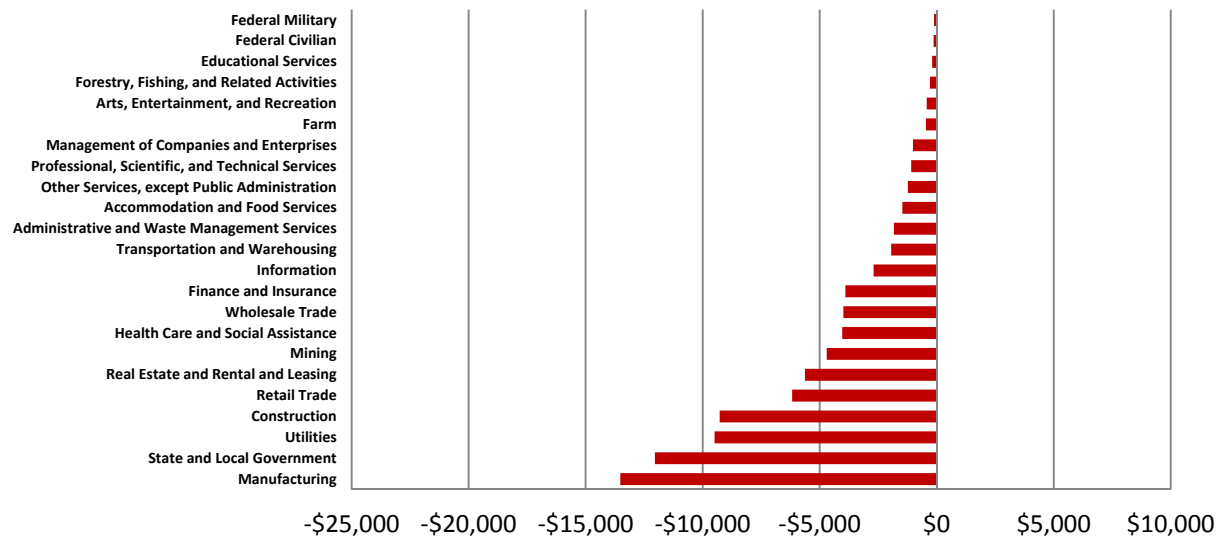
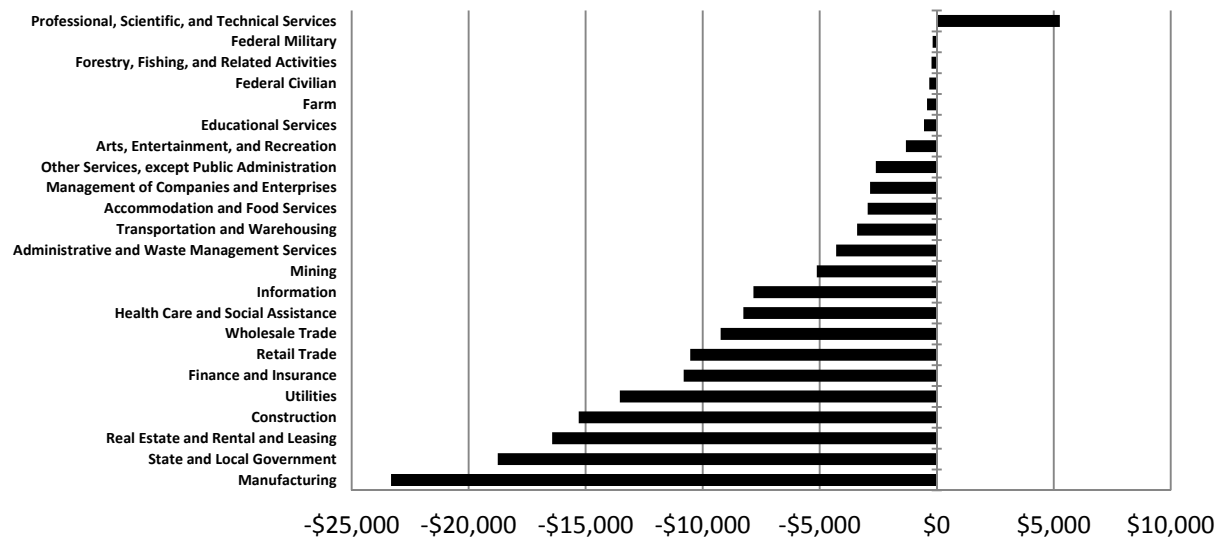


Figure 3.4 Change in GDP By Sector (25% increase, Rest of USA, ann. avg. 2016-2040)
(millions of 2015\$)



Real Disposable Personal Income

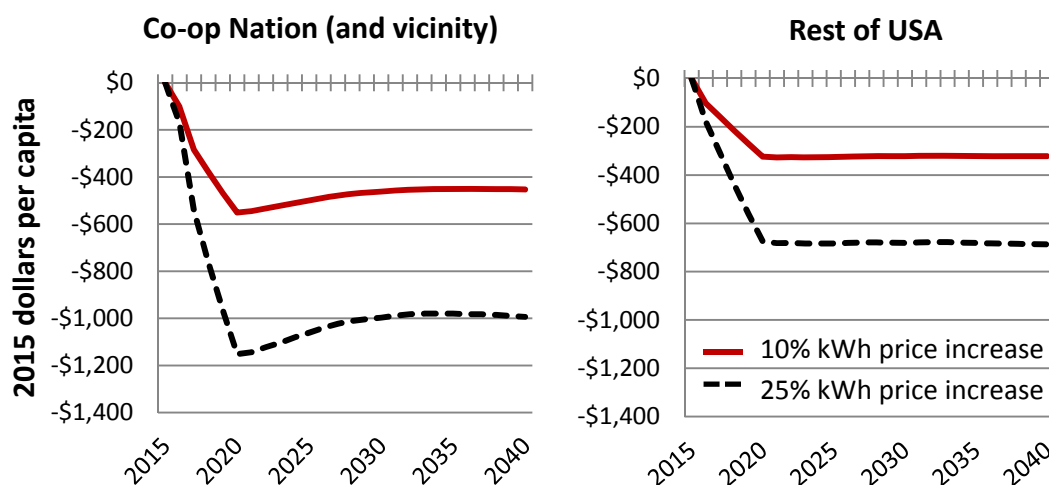
Figure 4 shows the impact to per capita real disposable personal income (RDPI). RDPI is the net of labor and capital income, minus taxes, and adjusted for a price index (including housing prices and electricity prices) to make real income. The impact on RDPI stays relatively constant despite a “pinch” in jobs towards the baseline. This implies reduced hours and wages for the average employee in the 10% and 25% increase cases.

Over the 2020-2040 period, the decline in average per capita real disposable income in Co-op Nation and vicinity is \$479 and \$1028 annually in the 10% and 25% electricity price increase scenarios, respectively. In comparison, the rest of the U.S. incurs smaller annual average losses of \$323 and \$681, respectively. Overall, the decline in per capita real disposable income in Co-op Nation and vicinity is about 50% greater than in the rest of the U.S.

The impact to per capita RDPI, compared to the GDP impacts shown in the top panels in Figure 3, produces close to the same influence overall. In the general REMI model, RDPI is around 70% of GDP (i.e., household income is around 70% of the economy). The comparable result between RDPI and GDP here comes from the effect to real income to households from a higher price index and the “pass down” of higher production costs for businesses to consumer prices.

The larger, more diverse economy of the urban United States makes it less subject to disturbances in electricity prices. Hence, the per capita income impacts by year in the region are less than they are in Co-op Nation and vicinity.

Figure 4 Per Capita Real Disposable Income

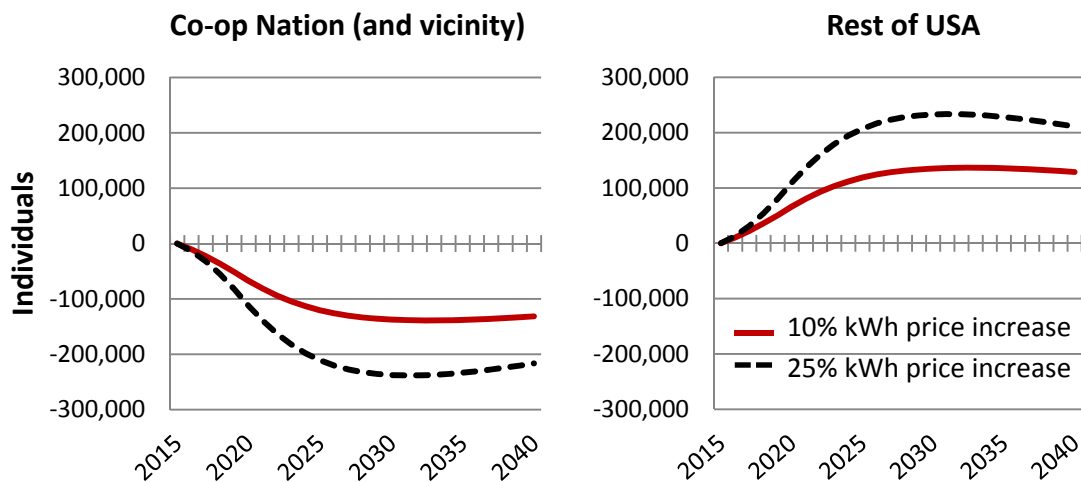


Population

Unlike the economy, demographics are a “zero-sum” game in the PI^+ model. The better or stronger national economy might change international migration patterns; however, within the United States, households have only the fifty states (or two regions here) presented to them. The PI^+ model adjusts

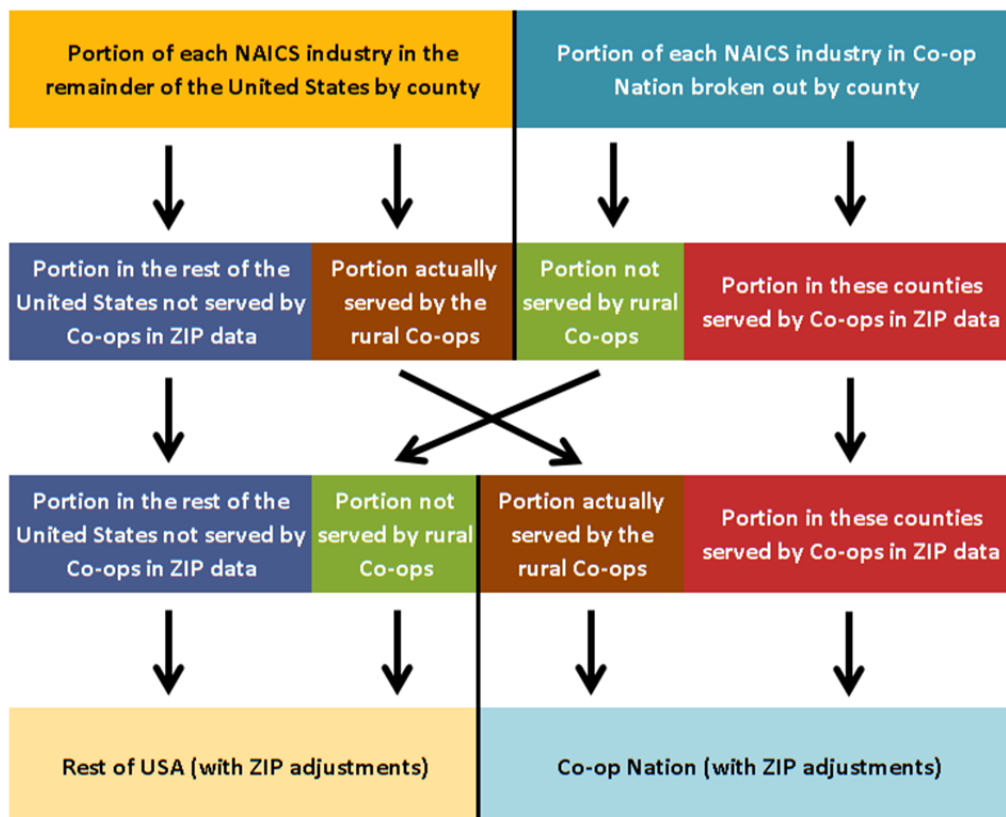
long-term household locations based on the quality of the labor market, the cost of living, and other factors. The change in the cost of living is not different between the regions here. However, the relatively higher level of job availability in the United States outside Co-op Nation induces households to be more likely to choose urban American instead of more rural locations. As a result, the rest of the United States tends to do “better” or “less bad” in the 10% and 25% electricity price change cases and they gain population at the expense of more rural areas.

Figure 5 Population Migration



Appendix 1

The flowchart below describes the process of the ZIP adjustments in the results for a given industry. The top row shows the breakout of counties into co-op and non-co-op regions. While the counties provide strong geographic granularity and match up with federal economic and demographic data, they do not precisely follow the service territories of the electrical grid. The second row separates the county-level results for an industry, based on the share of employment by sector in zip codes served by electric co-ops. The third row adjusts the results by adding the co-op portion of output from non-co-op counties to the co-op results, and removing the portion of output in co-op counties that is not attributable to co-ops and moving it to the results for the rest. In the figure, this is represented by swapping the “false positive” data in green with the “false negative” data in brown. This process allows for a more granular calculation of the industry-level results, by reallocating these ZIP code-level portions to the correct category. This adjustment is used to compute employment and GDP (business activity) impacts only. Because government data counts personal income at the place of residence and not at the place of employment, and given there is so much commuting between rural and urban areas in the United States, the per capita income results are reported at the county-level.



Appendix 2

Preexisting Industry Mixture by Region (2012)

NAICS	Co-op Jobs (thousands)	Co-op GDP (millions)	Rest of USA Jobs (thousands)	Rest of USA GDP (millions)
Forestry, Fishing, and Related Activities	355	\$18,951	510	\$21,856
Mining	638	\$145,007	690	\$274,318
Utilities	198	\$96,379	377	\$207,634
Construction	2,703	\$155,200	6,128	\$441,347
Manufacturing	4,032	\$566,439	8,562	\$1,521,322
Wholesale Trade	1,453	\$187,423	4,847	\$721,351
Retail Trade	5,167	\$268,042	13,018	\$742,581
Transportation and Warehousing	1,529	\$131,180	4,310	\$377,214
Information	625	\$126,006	2,633	\$595,956
Finance and Insurance	2,065	\$203,404	7,921	\$1,090,870
Real Estate and Rental and Leasing	1,939	\$346,139	6,304	\$1,908,882
Professional, Scientific, and Technical Services	2,204	\$184,096	10,041	\$1,147,269
Management of Companies and Enterprises	374	\$42,063	1,793	\$257,805
Administrative and Waste Management Services	2,531	\$102,146	8,557	\$413,412
Educational Services	713	\$23,690	3,483	\$145,542
Health Care and Social Assistance	4,762	\$286,062	15,093	\$974,190
Arts, Entertainment, and Recreation	861	\$28,704	3,136	\$137,255
Accommodation and Food Services	3,373	\$115,711	9,426	\$377,739
Other Services, except Public Administration	2,851	\$96,843	7,693	\$316,671
State and Local Government	5,996	\$378,385	13,175	\$1,121,170
Federal Civilian	652	\$72,923	2,223	\$297,584
Federal Military	790	\$163,686	1,265	\$258,341
Farm	1,676	\$88,028	940	\$99,309
TOTAL OF ALL SECTORS =	47,487	\$3,826,507	132,123	\$13,449,619